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JOB PROGRESS REPORT

RESEARCH PROJECT SEGMENT

State of Montana

Project W-120-R-7 Name Statewide Wildlife Research

Study and Job Nos. BG-1.1 Job 1; BG-1.2 Jobs 1 and 2; BG-1.4 Jobs 1 and 2; BG-1.5 Job 1; BG-2.1 Jobs 1 and 2; BG-2.3 Job 1; and BG-2.4 Job 1. Title Statewide Deer Research

Period Covered: July 1, 1975 - June 30, 1976

Prepared by: Richard J. Mackie
Kenneth L. Hamlin
Craig J. Knowles
John G. Mundinger

Approved by: Eugene O. Allen
Wynn G. Freeman

Date: September 30, 1976

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INTRODUCTION

Deer, including mule deer and white-tailed deer, are the most common, most widely distributed, and most popular big game animal in Montana. In terms of hunter numbers, hunting licenses sold, and numbers of animals harvested, they probably represent the most important wildlife resource of the state.

Since 1970, the demand for deer, as indicated by numbers of licenses sold, has increased by one-third, while both numbers of deer, especially mule deer, and the amount of land open or accessible to hunters have declined. Thus hunter harvests and success have decreased while effort has increased sharply, especially in accessible areas. These changes have precipitated growing concern among game managers and biologists as to the future course of deer management in the State. Intensified demand in the face of declining deer numbers and/or land open to public hunting will require much more intensive and refined management to achieve maximum production on available habitat. Doubtless this will require a more detailed understanding of the population biology and habitat relationships of deer and of the factors limiting deer numbers in the diverse environments in which deer occur in Montana than is presently available. It will also require new or improved methodology for measuring population and habitat parameters, new guidelines for applying existing information and technology more effectively, and/or new criteria for interpreting field data in terms of management needs.

In 1975 a statewide research program was initiated to meet these needs and provide new or improved guidelines and methods for deer management as well as for consideration of habitat requirements and relationships of deer in other game, range, forest, and land uses and management practices. It entails concurrent, comparative studies of both mule deer and white-tailed deer in all of the major ecological or broad habitat types on which the two species occur. These studies will be both descriptive and evaluative. Basic descriptive research is required to provide essential baseline information concerning habitat requirements and relationships, clarify existing knowledge, and develop hypotheses concerning environmental requirements and relationships of deer.

Job Title: Population ecology and habitat relationships of mule deer in coniferous forest habitat of western Montana.

ABSTRACT:

The locations of major mule deer *(Odocoileus hemionus)* winter ranges in western Montana were mapped. These ranges were surveyed with the intent of selecting future study areas. Current budget and man-power limitations dictate that mule deer studies in the near future will be restricted to populations in the Swan Valley.

Job Title: Population ecology and habitat relationships of mule deer in coniferous forest habitat of western Montana.

Job Objective: To determine the environmental requirements of mule deer and factors regulating mule deer populations in the coniferous forest habitat of western Montana.

To determine the effects of various potentially competing land use and management practices upon mule deer in western Montana.

INTRODUCTION

One phase of the statewide deer research effort includes studies to evaluate the factors affecting populations of mule deer *(Odocoileus hemionus)* in the coniferous forest habitat of western Montana. During FY-76 the emphasis of this study was on reconnaissance of mule deer ranges in western Montana with the intent of locating suitable study areas.

METHODS

Personnel of Administrative Regions 1 and 2 of the Montana Department of Fish and Game were contacted and the distribution of mule deer within the respective regions was discussed. General surveys were made of those mule deer ranges that had the best potential for future study areas.

FINDINGS

Region 1

Small groups of mule deer winter in each of several creeks of the Clark Fork River Drainage in the vicinity of Thompson Falls. Typically, mule deer occur at mid-to upper slopes and in close association with old burns. Serviceberry *(Amelanchier alnifolia)* is an important winter browse species. Timbered overstories are dominated by ponderosa pine *(Pinus ponderosa)* and Douglas fir *(Pseudotsuga menziesii)*. Elk *(Cervus canadensis)* are a potential competitor on most of the mule deer wintering areas. Vehicle access onto these winter ranges is limited.

Observations of mule deer in the upper Swan River Valley were made incidental to a study of white-tailed deer *(Odocoileus virginiana)*. In this area mule deer winter on the slopes of the Swan Range. The animals move into the valley and are found in clearcuts and natural openings during the early spring.

Region 2

Several areas within the Clark Fork River Drainage in the vicinity of St. Regis winter small groups of mule deer. Important browse species include serviceberry and evergreen ceanothus *(Ceanothus velutinus)*. Timbered overstories are dominated by ponderosa pine and Douglas fir. Vehicle access onto these ranges also is limited.

Several areas close to Missoula support small populations of mule deer. Suburban development threatens much of this area.

Two areas within the Bitterroot Valley were included in the survey. One mule deer winter range occurs on an old extensive burn in Kootenai Creek. This area now is a brush range dominated by serviceberry, evergreen ceanothus, and ninebark *(Physocarpus malvaceous)*. There is no vehicle access to this site. The other area lies between Bass and Sweeney Creeks. In this area the overstory is an open-canopy ponderosa pine forest with an understory dominated by serviceberry, ninebark, and evergreen ceanothus.

Several mule deer winter ranges occur on the lower south slopes of the Garnet Range in the vicinity of Drummond. This area is typified by browse ranges dominated by antelope bitterbrush *(Purshia tridentata)*, Rocky Mountain juniper *(Juniperus scopulorum)*, and rubber rabbitbrush *(Chrysothamnus nauseousus)*. Douglas fir is the dominant timber species. Roads occur through several of these ranges.

CONCLUSIONS AND RECOMMENDATIONS

Results were not entirely conclusive with respect to defining the most suitable location for intensive studies of mule deer in western Montana. Because of this, plus the fact that funding and manpower will limit the nature and intensity of mule deer studies in this area, it is recommended that additional time and effort be directed to evaluation of the Swan Range and Valley and mule deer populations therein as a potential study area. This work could be conducted in conjunction with existing studies of white-tailed deer in the Swan Valley.

Submitted by: John G. Mundinger

Job Title: Population ecology and habitat relationships of white-tailed deer in coniferous forest habitat of northwestern Montana.

ABSTRACT:

A study to evaluate the factors affecting populations of white-tailed deer *(Odocoileus virginiana)* in the Swan River Valley, Montana, was initiated in November 1975. A summary of previous studies of this herd is presented. A check station was operated during the 1975 hunting season. This provided information regarding the distribution of hunters and the harvest, age structure of the harvest, and average hog-dressed weights of deer. Population parameters were estimated from a harvest sample of 62 animals, a trapping sample of 118 animals, a road-kill sample of 29 deer, and classifications of 2,269 deer observed during the winter. Fawns comprised 31 percent of the harvest during the either-sex portion of the hunting season and 21 percent of the total harvest. Fawns comprised 35, 24, and 28 percent of the trapping, road-kill and winter classification samples, respectively. Yearlings represented 26, 19, and 23 percent, respectively, of the harvest, trapping, and road-kill samples. Reproductive tracts were collected from 13 female deer. These indicated fetal rates of 0, 1.0, and 1.5 for fawn, yearling, and adult does, respectively. Winter food habits were determined from analysis of rumen samples and feeding sites. Browse was the dominant forage class and the importance of several species in the diet was indicated. The winter distribution of deer was restricted to timbered areas, typically mixed stands of Douglas fir *(Pseudotsuga menziesii)*, western larch *(Larix occidentalis)*, and lodgepole pine *(Pinus contorta)*. Movements by some individual deer were recorded during early January. Thereafter, individuals were sedentary until early April and winter home ranges generally were less than 160 acres. Summer dispersal began during early April and was completed by mid-June. Distances traveled by nine radio-equipped does ranged from 12 to 45 miles. Eight transects were established to provide a description of the winter range vegetation and to estimate production and utilization of serviceberry *(Amelanchier alnifolia)*. Overstories were dominated by mixed timber; understories were mixed shrub/mixed forb communities. A linear relationship between percent canopy closure and deer use was indicated.

Job Title: Population ecology and habitat relationships of white-tailed deer in coniferous forest habitat of northwestern Montana.

Job Objective: To determine the environmental requirements of white-tailed deer and factors regulating white-tailed deer populations in the coniferous forest habitat of northwestern Montana.

To determine the effects of various potentially competing land use and management practices upon white-tailed deer in northwestern Montana.

To develop new and improved guidelines for management of northwestern Montana white-tail populations and their habitats.

INTRODUCTION

A study to evaluate the factors affecting populations of white-tailed deer *(Odocoileus virginiana)* in the coniferous forest habitat of western Montana was initiated in November 1975. This study is one phase of a statewide deer research effort to provide more detailed information on the biology and ecological relationships of deer and to provide new and improved guidelines and methods for deer management.

During FY-76 the emphasis of this study was on gathering data basic to the distribution, movements, habitat use, and population dynamics of two white-tailed deer populations. This report summarizes information about the deer population which winters in the upper Swan River Valley. Data which concerns the herd that winters at Salmon Lake is reported as a separate sub-job.

DESCRIPTION OF STUDY AREA

Initial studies centered on the upper Swan River Valley winter range which was described by Hildebrand (1971). This area, which represents the major white-tailed deer winter range in the upper valley, extends from Dog Creek north to Goat Creek and from the Swan River to approximately 1 mile east of Highway 209 (Fig. 1). It also extends into Lion Creek and Squeezer Creek Canyons. Hildebrand (1971) mentioned deer use of additional ranges lying between Smith and Condon Creeks and between Barber and Cooney Creeks.

Bergeson (1943) and Rognrud (1949) also mentioned an area in the vicinity of Holland Lake that was not included in Hildebrand's (1971) description.

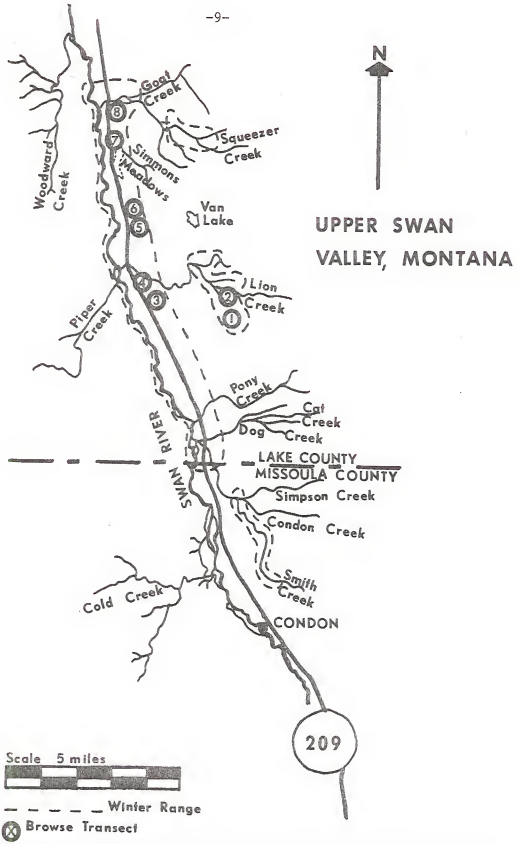

Figure 1. Map of the study area depicting approximate boundaries of the winter range and location of browse transects.

Approximately 50 percent of the upper Swan River Valley is publicly owned; 40 percent administered by the Flathead National Forest and 10 percent administered by the Swan River State Forest. The Burlington Northern Railroad owns approximately 40 percent of the land, and the remaining is owned by private individuals.

HISTORY OF WHITE-TAILED DEER POPULATIONS IN THE SWAN VALLEY

Bergeson (1943) indicated that little information was available regarding the game conditions in the Swan Valley prior to his study in 1942-43, and that information which was provided by the local inhabitants was contradictory. At that time it was believed that the white-tailed deer always had been present in the valley and that a peak population had been reached between 1900 and 1915. Large scale logging operations were at a peak in 1917 and these were believed to contribute to a rapid population decline. Bergeson (1943) thought that the repeal of the doe law in 1938 and the reduction in the mountain lion *(Felis concolor)* contributed to a slow, steady population increase.

Strip censuses were conducted by U. S. Forest Service personnel during the winters 1934-35 and 1935-36. These resulted in population estimates of 4,975 and 5,226 white-tailed deer, respectively (Bergeson 1943). Bergeson (1943) estimated the population at 5,511 during the winter 1942-43. During subsequent years portions of Bergeson's (1943) strip census were repeated. This resulted in population estimates of 6,069 during 1948-49 (Rognrud 1949), 6,785 during 1950-51 (McDowell 1951), and 2,022 during 1954-55 (Rognrud 1955). The value for 1954-55 was not directly comparable with those obtained during the earlier studies because this figure was only an estimate for the upper valley. However, the density index derived from the strip census indicated a considerable decline from the previous studies. A density index derived during the winter 1957-58 suggested an increase over the 1954-55 population level (Weckwerth 1958). All of the authors involved with the strip census indicated that results of this technique were quite variable, because they were responsive to factors other than deer numbers. The strip census was discontinued after 1958.

METHODS

Food Habits

Food habits of white-tailed deer were determined by the examination of feeding sites and rumen samples. Feeding sites were examined soon after being vacated by the animal(s). One nip on a forb or browse leader or one bite of grass was recorded as an instance of use (Knowlton 1960). The number of instances of use for each taxon was computed as a percentage of the total for each feeding site. A general description of the overstory and understory vegetation was made at each feeding site.

A one-quart rumen sample was collected from each intact carcass encountered. Rumen contents were examined according to the technique described

by Wilkins (1957). Analysis of the data from the rumen samples followed the aggregate percentage method described by Martin et al. (1946).

Distribution and Movements

All observations of deer were plotted, as accurately as possible, according to the legal description of the location. A general description of the surrounding habitat also was made.

Additional information resulted from the relocation of animals marked for individual recognition. One hundred and fifteen deer were captured during January-April 1976 using Clover traps (Clover 1954), Oregon style panel traps (Lightfoot and Maw 1963) and a cannon net (Hawkins et al. 1968). Of these, 104 were marked with an Armortite neck-band and 11 were equipped with radio transmitters.

Vegetation

A classification of the Habitat Types (Pfister et al. 1974) for that portion of the upper Swan Valley within the boundary of the Swan River State Forest has been completed by personnel of the Montana State Forestry Department. Classification of habitat types within the remaining portion of the upper Swan Valley as well as present cover types associated with the various habitat types within the boundaries of the white-tailed deer winter range will be completed by project personnel during the progression of this study.

Eight permanent browse transects were established during spring 1976, and additional transects will be established during future years. Transects were located according to known areas of deer concentration. Each transect consisted of 20 sampling points located at random distances, from 6 to 20 meters apart. The points were arranged in a 2x10, 4x5, or 3x6 with two additional points rectangular pattern, with the pattern selected to conform to the configuration of the stand in which each transect was located.

Tree and shrub densities were measured on each transect using the point-centered quarter method (Cottam and Curtis 1956). The species and distance from the point for the nearest tree and shrub in each quadrant of the sampling point were recorded. Canopy coverage of the low-growing taxa was determined with a modification of the technique described by Daubenmire (1959). A 4x10 dm. frame with a 2x5 dm. frame included in one corner was centered over each sampling point. The canopy coverage of bare ground; rock; litter; the forage classes of grasses and forbs; and each taxon of grasses and forbs was visually determined and assigned to one of six coverage classes, according to their occurrence in the 2x5 dm. plot. The coverage class of shrubs and each shrub taxon was determined within the 4x10 dm. plot. Coverage classes were: Class 1 = 0-5; class 2 = 5-25; class 3 = 25-50; class 4 = 50-75; class 5 = 75-95; class 6 = 95-100 percent. The mid-point of each class was used in calculations. Overstory

canopy closure was estimated for each transect by recording four densitometer readings (Lemmon 1956) at each sampling point.

One serviceberry *(Amelanchier alnifolia)* plant was tagged at each sampling point. On two of the transects mountain maple *(Acer glabrum)* also was tagged. On one transect rose *(Rosa* spp.) also was tagged. Utilization was estimated by counting all of the leaders on the tagged plants, and expressed as the percent of browsed leaders per plant. Production was estimated from the average number of leaders per plant and the density of the plants. Tagged plants will be examined again during fall 1976 and individual leaders will be measured and tagged.

Pellet group transects were established on each browse transect. All pellet groups which occurred within a circle with an area of 100 square feet, centered on the sampling points, were counted and recorded as deer or elk.

A reference plant collection was initiated during spring 1976. This collection will continue through the duration of the project.

RESULTS AND DISCUSSION

Check Station

Ninety-eight white-tailed deer, 51 elk, and 13 mule deer *(Odocoileus hemionus)*, harvested in the Swan River Valley, were recorded at the check station. The total harvest for Hunting District 130, as estimated by the hunter questionnaire, was 458 white-tailed deer, 188 elk, and 49 mule deer.

White-tailed deer were harvested throughout the valley. Areas which made the largest contributions to the harvest included Condon, Squeezer Creek and Van Lake. Elk were harvested in several drainages, with the largest numbers taken in the Elk Creek, Soup Creek-Cilly Creek, and Lost Creek areas. Mule deer were harvested in 7 drainages. Lost Creek and Lion Creek were the only areas in which more than one mule deer was taken. The distribution of hunters and the harvest of white-tailed deer and elk was closely associated with the pattern of roads in the valley. The few hunters who primarily pursued mule deer, walked.

The age distribution of the 1975 white-tailed deer harvest is compared with age data collected during earlier years in Table 1. Hildebrand (1971) noted a trend toward a reduction in the number of animals in the 4+-age-class. This trend appears to be reversing.

Weights of white-tailed deer harvested during 1975 are presented and compared with data collected during 1969 (Hildebrand 1971) (Table 2). Considering the sample size, these data are comparable. Compared with "average" Montana white-tailed deer (Mackie 1964), deer harvested in the Swan Valley appear to be heavier.

Table 1. Percent composition, by age-class, of the white-tailed deer harvest from the Swan River Valley, 1951-1976.

Year	1/2	1-1/2	2-1/2	3-1/2	4+	Sample Size
1951[1]	19	31	22	16	12	170
1951[2]	22		- - 78[3] - -			91
1952	31		- - 69 - -			120
1953[4]	10	33	24	5	29	21
1953[4]	9		- - 91 - -			199
1954	30		- - 70 - -			132
1957	30	14	14	17	25	164
1958	18	47	6	12	17	68
1959	21	18	16	7	38	57
1962	23	36	14	9	18	22
1969	31	26	14	15	14	78
1975[5]	21	26	14	13	26	62

[1]Sample includes animals harvested both in the Swan and Clearwater drainages
[2]Sample from the Swan Valley only
[3]Includes all age classes 1-1/2 and older
[4]A total of 199 animals were checked; only 21 were aged to specific year classes
[5]Age data preliminary, based on eruption/wear only

Table 2. Average hog-dressed weights, in pounds, of white-tailed deer harvested in the Swan River Valley during 1969 and 1975.

	Males Weight		Females Weight	
Age-class	1969	1975	1969	1975
1/2	66 (10)[1]	63 (4)	61 (7)	60 (4)
1-1/2	115 (10)	119 (7)	108 (2)	90 (1)
2-1/2[2]	161 (3)	160 (5)	116 (3)	103 (2)
3-1/2	163 (4)	150 (4)	118 (3)	110 (3)
4-1/2	182 (5)	178 (2)		115 (1)
5+	175 (3)	193 (6)		105 (2)

[1]Sample size in parentheses
[2]1975 age data preliminary, based on eruption/wear only

Productivity

Data gathered during the hunting season provided some indication of recruitment during 1974-75 and fawn production during the spring of 1975. Three of 15 (20%) adult females, 13 of 33 (39%) adult males, 16 of 49 (33%) adults, and 26 percent of the total white-tailed deer harvested were yearlings. Fawn/adult and fawn/doe ratios of the harvest were 45/100 and 87/100, respectively. The adult female/adult male ratio was 107/100.

Fawn/adult and fawn/doe ratios in the road kill sample were 43/100 and 64/100, respectively (Table 3). Hildebrand (1971) indicated that his road kill sample was biased toward fawns. This apparently was not the case during 1976. Yearlings comprised 17 percent of the road-kill sample, and the adult female/adult male ratio was 157/100.

Fawn/adult and fawn/doe ratios in the trapping sample were 53/100 and 71/100, respectively (Table 4). These values probably reflect an increased vulnerability of fawns to bait-trapping. The ratio of adult females to adult males suggests a bias against adult males in this sample. Yearlings represented a smaller proportion of the trapping sample than either the harvest or road-kill samples.

During the January-April period 2,269 observations of white-tailed deer were made. Of these, 2,119 were classified according to age-class (Table 5). These data indicated a fawn/adult ratio of 39.5/100, or a population comprised of 28.3 percent fawns. Classifications by monthly intervals indicated an increase in the fawn/adult ratio from January to February, a decline from February to March, and an increase from March to April. These changes probably were related to differential observability of adult males. Groups comprised entirely of adults, and presumably all adult males, frequently were observed during March.

Fawn/adult ratios observed in previous years have fluctuated widely (Table 6). A value of 39.5/100 is below the 1941-1976 average of 55/100 and below that (45/100) observed by Hildebrand (1971) during 1970, but within the range of fluctuation observed since 1941.

A summary of the data in the sample of reproductive tracts is included in Table 7. In this sample there was no evidence of breeding by fawns. All females, one-and-one-half-years and older, were pregnant. For the yearling age-class the fetal and ovulation rates each were 1.0 per doe. Fetal and ovulation rates for the adult age-class were 1.5 and 2.0 per doe, respectively.

Food Habits

Winter food habits of the white-tailed deer in the upper Swan River Valley were determined by the examination of the contents of 17 rumen samples (Table 8 and 9), and by the examination of 20 feeding sites, at which 284 instances of use were recorded (Table 10). Browse, forbs, grasses, and

Table 3. Sex and age classification of 29[1] white-tailed deer in the road-kill sample.

Sex	Fawn	Yearling	Adult
Female	4	3	8
Male	2	2	5
Unclassified	1	_	4
Total	7	5	17

7 fawns/22 adults = 32 fawns/100 adults, or 24% fawns
7 fawns/11 adult females = 64 fawns/100 adult females
3 yearlings of 11 adult females = 27% yearlings
2 yearlings of 7 adult males = 29% yearlings
5 yearlings of 22 adults = 23% yearlings
11 adult females/7 adult males = 157 adult females/100 adult males

[1]Sample includes 9 deer collected in the lower valley.

Table 4. Sex and age classification of 118 white-tailed deer in the trapping sample.

Sex	Fawn	Yearling	Adult
Female	18	10[1]	48[2]
Male	23	5	14
Total	41	15	62

41 fawns/77 adults = 53 fawns/100 adults, or 35% fawns
41 fawns/58 adult females = 71 fawns/100 adult females
10 yearlings of 58 adult females = 17% yearlings
5 yearlings of 19 adult males = 26% yearlings
15 yearlings of 77 adults = 19% yearlings
58 adult females/19 adult males = 305 adult females/100 adult males

[1]Sample includes one trap casualty.
[2]Sample includes two trap casualties.

Table 5. Monthly classifications of white-tailed deer in the upper Swan River Valley during the winter, 1976.

Month	Total	Classified	Adults	Fawns	Uncl.	ff/100 Ad.	%ff	% Uncl.
January	188	154	110	44	34	40	28.6	18.1
**		(37)	(24)	(13)		(54)	(35.1)	
February	518	485	335	150	33	45	30.9	6.4
*		(26)	(22)	(4)		(18)	(15.4)	
**		(43)	(27)	(16)		(63)	(37.2)	
March	1,458	1,378	1,002	376	80	38	27.3	5.6
*		(72)	(58)	(14)		(24)	(19.4)	
**		(90)	(60)	(30)		(50)	(33.3)	
April	105	102	72	30	3	42	29.4	2.9
Total	2,269	2,119	1,519	600	150	39.5	28.3	6.6

*Daily observation during the month with the lowest observed fawn/adult ratio
**Daily observation during the month with the highest observed fawn/adult ratio

Table 6. White-tailed deer fawn/adult ratios in the Swan River Valley, 1935-1976.

Year	Adults	Fawns	Unclassified	Fawns/100 Adults	Percent Fawns
1935*	19	56	1,122	294	74.7
1936*	49	21	1,522	43	30.0
1941	17	20	6	117	54.1
1943	45	56	17	124	55.4
1949	188	68	115	36	26.6
1950	214	87		41	28.9
1955	61	42	74	69	40.8
1958	167	99	139	59	37.2
1959	207	68		33	24.7
1960	77	30		39	28.0
1961	19	8		42	29.6
1962	80	33		41	29.2
1963	59	31		53	34.4
1964	234	90		38	27.8
1965	188	108		57	36.5
1966	33	17		52	34.0
1967				51	
1970	225	102		45	31.2
1976	1,519	600	150	39	28.3
Average				55	34.1

*excluded from the longterm average

Table 7. Summary of reproductive tract collections.

Age	Date	C.L. of Pregnancy	Embryos	C-R Length	Weight
1/2[1]*	1/23/76	0	0		
1/2 *	4/22/76	0	0		
1/2[1]*	6/15/76	0	0		
1-1/2[1]	1/22/76	1	1		
1-1/2	3/10/76	1	1FF	21 cm.	289 gm.
Adult	12/24/75	2	2		
Adult	12/24/75	2	(pregnant)		
Adult	1/17/76	2	1	5	5
			1	5	4
Adult	3/13/76	2	1MM	22	392
Adult	3/17/76	-	1MM	24	405
Adult	3/26/76	-	(pregnant)		
Adult	4/12/76	2	1MM	30	838
			1FF	29	805
Adult[1]	4/22/76	2	1MM	-	-

[1]deer collected in the lower Swan Valley

*fawns showing evidence of ovarian activity

Table 8. List of abbreviations of plant names used in this report.

Abbreviation	Nomenclature
Conifers	
Abgr	*Abies grandis*
Abla	*Abies lasiocarpa*
Juco	*Juniperus communis*
Laoc	*Larix occidentalis*
Pisp	*Picea* spp.
Pico	*Pinus contorta*
Pipo	*Pinus ponderosa*
Psme	*Pseudotsuga menziesii*
Thpl	*Thuja plicata*
Shrubs	
Acgl	*Acer glabrum*
Alin	*Alnus incana*
Amal	*Amalanchier alnifolia*
Arnu	*Aralia nudicaulis*
Aruv	*Arctostaphylos uva-ursi*
Bere	*Berberis repens*
Cesa	*Ceanothus sanguineus*
Ceve	*Ceanothus velutinus*
Loci	*Lonicera ciliosa*
Pamy	*Pachystima myrsinites*
Posp	*Populus* spp.
Rosp	*Rosa* spp.

Table 8. Continued

Abbreviation	Nomenclature
Shrubs (cont.)	
Rupa	*Rubus parviflorus*
Sasp	*Salix* spp.
Shca	*Sherpherdia canadensis*
Spbe	*Spiraea betulifolia*
Syal	*Symphoricarpos alba*
Vasp	*Vaccinium* spp.
Ferns	
Ptaq	*Pteridium aquilinium*
Forbs	
Acmi	*Achillea millefolium*
Ansp	*Antennaria* spp.
Arsp	*Arnica* spp.
Cani	*Calochortus nitidus*
Chum	*Chimaphila umbellata*
Cifo	*Cirsium foliosum*
Clun	*Clintonia uniflora*
Coca	*Cornus canadensis*
Epan	*Epilobium angustifolium*
Ersp	*Erigeron*
Ergr	*Erythronium grandiflorum*
Frvi	*Fragaria virginiana*
Gabo	*Galium boreale*

Table 8. Continued.

Abbreviation	Nomenclature
Forbs (cont.)	
Gevi	*Geranium viscosissimum*
Goob	*Goodyera oblongiflora*
Libo	*Linnaea borealis*
Lusp	*Lupinus* spp.
Pera	*Pedicularis racemosa*
Pysp	*Pyrola* spp.
Smra	*Smilacina racemosa*
Thsp	*Thalictrum* spp.
Xete	*Xerophyllum tenax*
Grass and grass-like plants	
Brsp	*Bromus* spp.
Caru	*Calamagrostis rubescens*
Casp	*Carex* spp.
Eltr	*Elymus triticoides*
Fesp	*Festuca* spp.

Table 9. Winter food habits of white-tailed deer as determined by the examination of 17 rumen samples

	December (3)[1]		January (3)		February (3)		March (5)		April (3)		Winter (17)	
Abgr			0.33[2]	2.5							0.06	0.4
Juco	1.0	20.4	1.0	28.5	0.67	0.7	0.4	1.5			0.59	9.2
Laoc			0.33	1.7							0.06	0.3
Pico	0.67	0.4	1.0	2.0	0.67	0.1	0.6	0.8	0.66	1.0	0.71	0.8
Pipo			0.67	0.6							0.12	0.1
Psme	1.0	8.5	1.0	10.2	1.0	2.5	1.0	3.5	1.0	19.4	1.0	8.3
Thpl					0.33	23	0.2	0.9			0.12	4.3
Total Conifer	1.0	29.3	1.0	43	1.0	28.8	1.0	7.0	1.0	20.4	1.0	23.2
Acgl	0.67	2.1					0.2	tr[3]	0.33	0.4	0.24	0.4
Alin	0.67	tr	0.67	tr	0.67	0.3	1.0	0.4	1.0	0.7	0.82	0.3
Amal	0.67	1.7	1.0	3.2	0.33	3.0	0.8	0.7	1.0	5.3	0.76	2.6
Aruv	1.0	4.4	1.0	6.9	0.67	1.4	0.2	0.5	0.66	2.0	0.65	2.7
Bere	1.0	27.1	1.0	6.7	1.0	19.3	1.0	65.2	1.0	37.8	1.0	40.5
Cesa	0.33	tr	0.67	3.5							0.18	0.6
Ceve	1.0	1.7	0.67	2.6	0.67	1.9	0.8	0.9	1.0	0.9	0.82	1.5
Pamy							0.4	0.7	0.67	14.2	0.24	2.7
Posp	0.33	0.5	0.33	tr							0.12	0.1
Rosp.	0.33	tr	0.33	tr							0.18	tr
Sasp.	1.0	7.9			0.67	1.5	0.8	0.8	0.33	0.4	0.59	2.0
Shca			0.33	tr	0.33	0.3					0.12	tr
Spbe	1.0	0.7	0.33	1.6	0.33	0.1	0.6	0.2	0.33	tr	0.59	0.5
Syal	0.33	0.4	0.33	tr							0.12	tr
Unid. Browse	1.0	7.9	1.0	24.8	0.75	25.9	0.8	2.2	0.67	7.1	0.82	12.2
Total Browse	1.0	54.4	1.0	49.5	1.0	53.7	1.0	89.6	1.0	68.7	1.0	66.3
Conifer & Browse	1.0	83.7	1.0	92.5	1.0	82.5	1.0	95.6	1.0	89.1	1.0	89.5
Ansp.	0.33	tr									0.06	tr
Chum	0.33	tr			0.67	0.8	0.2	tr			0.24	0.2
Ergr									0.67	0.2	0.12	tr
Frvr							0.2	tr			0.06	tr
Goob	0.33	2.1									0.06	0.4

Table 9. Continued

	December (3)		January (3)		February (3)		March (5)		April (3)		Winter (17)	
Libo	0.33	tr					0.6	0.5	0.33	0.3	0.29	0.2
Xete	0.66	2.2			1.0	1.5	0.8	2.0	0.67	6.5	0.65	2.4
Unid. Forbs	1.0	0.9	1.0	2.2	0.33	0.33	0.2	0.3	1.0	8.7	0.59	1.5
Total Forbs	1.0	5.3	1.0	2.2	1.0	5.5	1.0	2.9	1.0	8.7	1.0	4.7
Grass	0.66	9.6			0.33	tr	0.4	0.1	0.67	2.0	0.41	2.1
Allectoria spp.	0.33	0.3	0.67	3.2			0.2	tr			0.24	0.6
Larch bark	0.66	0.2	0.67	1.3	0.67	8.3	0.2	0.2			0.41	1.9
Sellaginella spp.			0.33	tr	0.67	3.4	0.2	tr			0.24	0.6
Lichen					0.33	tr					0.06	tr
Mushrooms	0.33	0.8	0.67	0.8			0.4	0.4	0.33	0.3	0.35	0.4
Equisetum spp.	0.33	0.1					0.2	tr			0.12	tr

[1]Sample size for the period
[2]Frequency of occurrence in rumen samples/percent of the diet
[3]tr = trace, percent of diet is less than 0.1 percent

Table 10. Winter food habits of white-tailed deer as determined by the examination of 20 feeding sites.

	Mid-Winter		Late-Winter		Winter Average	
Juco	[1]0.45	25.6	0.67	13.1	0.55	20.0
Pico	0.18	1.2	-	-	0.1	0.7
Pipo	0.09	0.4	0.22	0.6	0.15	0.5
Psme	0.18	2.4	0.22	1.1	0.2	1.8
Total Conifer	0.64	29.5	0.67	14.9	0.65	22.9
Acgl	0.36	5.5	0.11	2.1	0.25	4.0
Amal	1.0	26.5	0.67	7.8	0.85	18.1
Aruv	-	-	0.78	14.1	0.35	6.4
Bere	-	-	0.33	1.8	0.15	0.8
Cesa	0.55	6.6	0.11	0.2	0.35	3.8
Loci	0.18	0.7	0.33	4.1	0.25	2.3
Posp	0.09	0.9	-	-	0.05	0.5
Rosp	0.82	8.2	0.78	4.4	0.8	6.5
Rupa	0.09	3.1	0.44	12.4	0.25	7.3
Sasp	0.18	1.7	0.11	0.3	0.15	1.1
Shca	0.27	1.4	0.11	0.1	0.2	0.8
Spbe	0.82	9.3	0.89	10.7	0.85	9.9
Syal	0.27	4.2	0.33	0.6	0.30	1.0
Vasp	-	-	0.78	18.8	0.35	8.5
Unid. Browse	0.09	2.0	0.11	0.3	0.10	1.3
Total Browse	1.0	70.5	1.0	77.9	1.0	73.9
Browse & Conifer	1.0	100	1.0	92.8	1.0	96.8

Table 10. Continued

	Mid-Winter		Late-Winter		Winter Average	
Chum	-	-	0.67	2.2	0.3	1.0
Xete	-	-	0.33	4.7	0.15	2.1
Unid. Forbs			0.33	0.7	0.15	0.3
Total Forbs	-	-	0.89	7.4	0.4	3.4
Allectoria spp.[2]	0.64	-	0.33	-	0.50	-

[1]Frequency of occurrence at feeding sites/percent of the diet
[2]Instances of use not evaluated for this taxon

other materials comprised 89.5, 4.7, 2.1, and 3.5 percent, respectively, of the rumen contents. Browse and forbs comprised 96.8 and 3.4 percent, respectively, of the diet observed at feeding sites.

Oregon grape *(Berberis repens)*, common juniper *(Juniperus communis)*, and Douglas fir *(Pseudotsuga menziesii)* were major taxa found in the rumen samples. A variety of browse species was important in the feeding site examinations. Prevalent taxa were common juniper, western serviceberry, white spiraea *(Spiraea betulifolia)*, thimbleberry *(Rubus parviflorus)*, and rose. Huckleberry *(Vaccinium* spp.) and kinikinnick *(Arctostaphylos uva-ursi)* also were important taxa during late winter, after snow-melt had made these species available.

The importance of tree-moss *(Alectoria* spp.) in the winter diet of white-tailed deer was difficult to evaluate. Tree-moss was readily available on fallen branches of western larch *(Larix occidentalis)* and deer frequently were observed feeding on this material. Use of tree-moss was indicated at 50 percent of the feeding sites, however, instances of use could not be counted. Tree-moss and/or larch bark was present in 65 percent of the rumen samples, but the tree-moss always was present in small quantities.

Winter food habits observed during 1976 generally were consistent with those observed during 1957-58 (Weckwerth 1958) and during 1970 (Hildebrand 1971).

Distribution and Range Use

Observations on the winter distribution of white-tailed deer in the upper Swan River Valley during 1976 were similar to that described by Hildebrand (1971). This distribution is depicted in Figure 1.

Within this general distribution, almost all observations of deer occurred within mixed stands of mature timber. In these stands, Douglas fir, western larch, and lodgepole pine *(Pinus contorta)* typically were co-dominant species.

Use of natural openings and clearcuts was minor, typically limited to single, well established trails which connected two stands of timber. Hildebrand (1971) suggested that open areas were not available for deer use because of the increased snow depths. Other microclimatic differences also might be involved.

Use of clearcuts greatly increased during a brief period following snow-melt and prior to dispersal of the deer to summer ranges. Clearcuts bared more rapidly than other areas and were the first sites of spring "green-up".

Home Range

Relocations of 23 collared deer were sufficient to provide estimates of the home range area for these animals. The rectangular area which included all observations of the individual deer was assumed to represent the winter home range area. By this method, the home range areas ranged from 31 to 220 acres, with a mean of 81.2 acres (s.e. = 9.5).

In a manner similar to that described by Schwarzkoph (1973), average activity radii also were calculated for these deer. This resulted in an estimate for the average home range area of 308.7 acres. Calculation of home range area, based on the average activity radius, assumed that the home range of an animal was a circle with a radius equal to twice the average activity radius. This assumption, however, could not be supported by ground observations. The larger estimates were, therefore, influenced by the deviations from circular home ranges.

Another method was employed to calculate the home range area for 4 of the radio-equipped animals. Probable home range perimeters were plotted on aerial photographs, based on frequent fixes, observations, and general information on the distribution of deer within these areas. These perimeters were traced onto quadrille paper and the included areas calculated. By this method, home range areas ranged from 89 to 141 acres, with a mean of 122 acres. Frequent fixes were obtained from 3 additional radio-equipped deer. Although these data were not sufficient to provide estimates of the respective home range perimeters, they did indicate that these deer had distinct affinities for areas of less than one-quarter section, 160 acres. Information obtained from the remaining radio-equipped deer did not permit definite conclusions, however, it was not inconsistent with the above observations.

Movements

Winter

Trapping was initiated during the first week in January. At that time the distribution of deer apparently was similar to that depicted in Figure 1, except that large numbers of deer were not present in the Goat Creek area and in Lion Creek Canyon.

During late January and early February movements by some individual deer occurred. Three deer, which were collared in the vicinity of Dog Creek, moved approximately two, five and six miles, respectively, northward from that trapsite. Two radio-equipped deer, which were captured 2 miles south of Lion Creek, moved approximately four miles north to an area southeast of Simmons Meadows. Another radio-equipped deer, which had been captured at the same time, moved approximately two miles east into Lion Creek Canyon. Following these movements, the winter home ranges of these deer were stable. Other animals, which had been captured at the same locations, continued to use home ranges which included these trapsites. Coincident with these recorded movements, larger numbers of deer were observed in the Goat Creek and Lion Creek Canyon areas.

Summer

Information regarding the dispersal of deer from the winter range resulted from movements made by nine radio-equipped animals (Fig. 2). The first indication of summer dispersal was recorded during mid-March, during a period of snow-melt. The radio-equipped deer in Lion Creek Canyon moved back to the area where she had been captured. Following another snow-fall, she returned to the area where she had wintered.

All of the radio-equipped deer had demonstrated evidence of dispersal during early to mid-April. Initially, this appeared as an enlargement of the winter home range area. Subsequently, ground contact with these deer was lost, an indication that the winter home ranges had been vacated.

Radio contact was reestablished during flights. The time necessary to migrate and localize within a summer home range varied between individual deer. Three of the radio-equipped deer were established on their summer ranges by early May. These deer had moved 14, 15, and 21 miles, respectively. A fourth deer, which had moved approximately 24 miles, was established on its summer range by late May. Three more deer were established on their summering areas by mid-June. These animals had moved 12, 35, and 40 miles from their respective winter ranges.

The histories of two of the radio-equipped deer were complicated by problems of equipment failure and/or possible confusion with animals that had been collared in the Salmon Lake area. The tentative summer locations of these animals were 40 and 45 miles from the respective winter ranges.

Following the localization by deer to their respective summering areas, the degree of movement recorded between flights was variable. However, the indicated summer home range area of each of these deer was less than one-square-mile.

The pattern of dispersal is presented in Figure 2. The primary direction of movement from the Goat Creek-Dog Creek wintering area was south. This pattern was consistent with observations of collared deer. The majority of reported observations occurred between Condon and Seeley Lake.

Assuming that the tentative locations of the two problem deer were correct, five of the radio-equipped deer crossed the Swan-Clearwater divide. Apparently, a substantial proportion of the upper Swan Valley winter herd summers in the Clearwater drainage.

Vegetation

The approximate location of each browse transect is plotted in Figure 1. Estimates of tree and shrub densities are presented in Table 11. These data indicate that white-tailed deer wintered in stands of mixed timber. Important species in the timbered overstory were Douglas fir, lodgepole pine, and western larch.

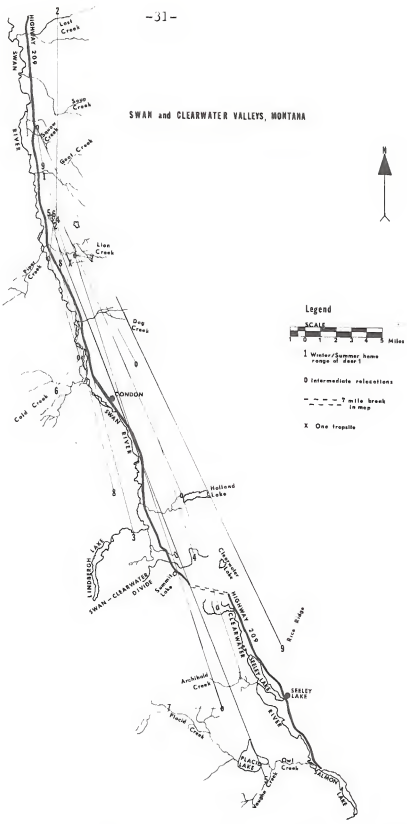

Figure 2. Summer dispersal of nine radio-equipped white-tailed deer.

Table 11. Tree and shrub density and percent canopy closure on each of eight browse transects.

	1	2	3	4	5	6	7	8
Trees/Acre								
Abgr						18	22	60
Abla			7					23
Laoc	28	63	80	72	101	87	177	68
Pisp			7	180	24	4	66	203
Pico	6	171	53	86	172	9	66	243
Pipo	68		3		10	22	17	7
Psme	22	126	116	238	77	209	94	98
Shrubs/Acre								
Acgl	220		214					
Amal	2,378	2,385	304	56	414	345	240	274
Arnu								1,419
Loci					5,394			7,803
Pamy	1,528							
Rosp	5,349	9,519	8,236	5,769	17,262	3,581	3,176	7,803
Rupa			8,785		1,079			
Spbe	28,271	12,699	17,021	16,290	23,735	26,854	39,699	21,990
Syal	13,754	15,834	1,098	2,039	4,315	8,355	3,176	
Vasp		5,715	7,138	2,715	30,209	7,161	17,467	17,734
% Canopy Closure	74.3	91.3	89.0	95.1	70.6	90.7	89.3	94.8

Frequency and percent canopy coverage of the understaory vegetation are included in Table 12. Understories were mixed shrub/mixed forb communities. Dominant shrubs included white spiraea, huckleberry, Oregon grape, rose, kinikinnick, and snowberry *(Symphoricarpos albus)*. Important forbs included strawberry *(Fragaria virginiana)*, one-flowered clintonia *(Clintonia uniflora)*, twin-flower *(Linnaea borealis)*, and arnica *(Arnica* spp.). Pine reedgrass *(Calamagrostis rubescens)* was the only important grass-like plant in the understory.

Percent canopy closure of the overstory ranged between 70 and 95 percent, and averaged 87 percent (Table 11). A linear relationship between percent canopy closure and deer use, as indicated by the number of pellet groups per acre (Table 13), was indicated ($R = 0.76$, $P < 0.05$, $t = 2.84$, $P < 0.05$.)

Production and utilization of serviceberry also is included in Table 13. No relationship was evident between utilization of serviceberry and deer use. Data suggested inverse relationships between utilization of serviceberry and the production of this species and between serviceberry utilization and the density of white spiraea, however, statistical tests were not significant ($P > 0.05$).

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Table 12. Frequency/percent canopy coverage of plant taxa occurring on each of eight browse transects.

	1	2	3	4	5	6	7	8
Bare Ground	0.75/ 3.4	0. 3/0.75	0. 2/ 4.8		0.05/ Tr[1]			0.05/0. 8
Rock		0.05/0.75	0.05/ 0.8					
Moss	0. 1/ 0.3	0. 3/7. 3		0. 3/ 3.3				0. 2/1. 8
Lichen		0.05/ Tr		0. 1/ 1.5				0.05/ Tr
Litter	1. 0/87.9	1. 0/83.8	1. 0/83.0	1. 0/87.8	1. 0/91.4	1. 0/90.9	1. 0/85.0	1. 0/91.0
Grass	0.65/15.4	0. 8/19.9	0.65/ 6.5	0. 8/19.3	0.85/18.3	0.95/22.5	1. 0/37.6	0.95/18.0
Brsp			0.05/ Tr		0. 1/ 0.3			0. 2/ 0.5
Caru	0.55/11.6	0.75/19.1	0. 6/ 6.4	0. 8/19.3	0.85/18.3	0.95/22.5	1. 0/37.6	0. 9/16.1
Casp	0. 1/ 1.5						0.05/ Tr	0. 1/ 1.5
Eltr				0.05/ Tr				0.05/ Tr
Fesp			0.05/ Tr		0.05/ Tr			
Forbs	0. 9/29.9	1. 0/50.6	0. 7/23.3	0.95/28.5	0.95/29.8	1. 0/28.4	0.95/25.1	1. 0/51.0
Acmi	0. 1/ 0.3				0.15/ 0.4		0.15/ 1.0	0.05/ Tr
Arsp	0. 7/10.8	0.55/ 6.9	0.25/ 3.6	0.65/10.3	0.25/ 4.3	0.35/ 5.8	0. 4/ 4.8	0.35/ 5.8
Cani			0.05/ Tr				0.05/ Tr	0.05/ Tr
Chum	0. 2/ 1.1	0. 4/ 2.9	0. 1/ 0.3	0. 1/ 0.9	0.25/ 4.9	0.05/ 0.8		0.35/ 4.6
Cifo					0.05/ Tr			
Clun		0. 5/10.4	0. 7/11.5	0.45/ 6.6	0. 4/ 7.1	0.05/ 0.8	0. 4/ 9.5	0. 8/17.8
Coca	0. 2/ 1.1		0. 4/ 6.4		0.25/ 3.8		0.05/ 0.8	0.25/ 4.9
Epan	0.05/ Tr		0.05/ Tr		0.05/ Tr		0.05/ 0.8	
Ersp								0.25/ 2.5
Ergr		0. 1/ 0.3						
Frvi	0.85/10.1	0. 7/15.1	0. 3/ 2.6	0.35/ 4.0	0.55/ 8.3	0.95/17.4	0. 9/13.9	0.25/ 3.1
Gabo			0.05/ Tr	0.25/ 1.9	0. 2/ 2.4	0. 2/ 1.0	0.25/ 1.9	0.05/ Tr
Gevi							0.05/ 0.8	
Libo	0. 3/ 2.0	0.65/10.6	0.25/ 3.6	0. 3/10.4	0. 3/ 3.1	0.05/ Tr	0.25/ 6.6	0.75/17.6
Lusp		0.65/10.0		0.05/ Tr		0. 3/ 3.3	0.05/ 0.8	0. 1/ 0.9
Pera								0. 1/ 0.9
Pysp			0. 3/ 2.6	0. 1/ 0.9	0.05/ Tr	0. 3/ 1.4	0. 1/ 0.8	0. 3/ 2.6
Smra		0. 1/ 2.0	0. 5/ 4.4	0.15/ 3.4	0.25/ 3.1	0. 4/ 4.8	0.05/ 0.8	0.25/ 3.1
Thsp	0.15/ 0.4	0.35/ 5.8	0.35/ 4.0	0.25/ 1.9	0. 3/ 5.0	0.15/ 2.3		0.15/ 3.4
Unid. Forbs	0. 2/ 1.8	0.35/ 4.5	0.05/ Tr	0.05/ 0.8		0. 2/ 3.5	0.02/ 0.5	0.45/ 9.0
Shrubs	1. 0/63.1	0.95/44.8	0. 9/45.6	1. 0/31.9	1. 0/53.6	1. 0/49.0	1. 0/40.5	1. 0/36.1
Acgl	0.15/ 6.9	0.05/ Tr	0. 1/ 1.9		0/ Tr			0/ Tr
Amal	0.45/12.5	0.35/ 6.3	0.05/ 0.8	0.05/ 0.8	0.15/ 5.1	0. 2/ 4.1	0/ Tr	0/ Tr
Arnu		0/ Tr						0. 1/ 1.5
Arvu	0.45/13.8	0. 2/ 4.1	0.15/ 5.6	0. 2/ 5.1	0. 2/ 4.6	0.45/ 9.0	0.75/13.3	0.25/ 2.4

Table 12. Continued

	1	2	3	4	5	6	7	8
Shrubs (cont.)								
Bere	0.55/ 6.4	0.65/ 9.6	0.45/ 3.6	0. 6/ 6.3	0. 8/11.9	0.75/ 8.8	0.75/ 9.8	0.65/ 7.9
Juco		0/ Tr		0/ Tr		0/ Tr	0.05/ 0.8	0.05/ 0.8
Loci	0.05/ 0.8	0. 5/ 4.9	0.05/ 0.8		0. 4/ 3.5	0. 1/ 0.3	0.65/ 2.3	0.65/ 6.6
Pamy	0/ Tr							0.05/ Tr
Ptaq					0. 3/10.4			0/ Tr
Rosp	0.35/ 9.8	0.55/ 9.8	0.55/ 6.8	0.4/ 7.1	0. 6/ 9.4	0. 4/ 6.5	0. 4/ 5.9	0. 5/ 6.3
Rupa		0/ Tr	0. 7/18.9		0. 1/ 0.9			0/ Tr
Sasp				0/ Tr	0.05/ 0.8	0/ Tr		0/ Tr
Shca		0.05/ 0.8	0.05/ 0.8	0/ Tr	0/ Tr	0/ Tr	0/ Tr	
Spbe	0. 8/17.5	0. 7/ 6.6	0.85/12.5	0.85/18.0	0. 7/15.5	1. 0/19.3	0. 9/16.1	0. 9/16.1
Syal	0.75/14.6	0. 7/14.3	0. 1/ 0.9	0.15/ 2.3	0. 2/ 3.0	0.55/12.8	0. 1/ 2.6	0.15/ 2.3
Vasp	0.05/ Tr	0.45/ 4.3	0.65/12.6	0. 5/ 5.0	0. 7/13.3	0. 6/11.1	0. 8/13.4	0. 7/ 8.9
Conifer regeneration	0. 2/ 1.1	0.05/ 1.9	0. 1/ 0.3	0.05/ Tr	0.05/ 1.9	0. 1/ 1.5	0.15/ 1.0	2. 0/ 3.3
Abgr								0.05/ 0.8
Pico	0. 1/ 0.9							
Pipo			0.05/ Tr					0. 1/ 1.5
Psme	0. 1/ 0.3	0.05/ 1.9	0.05/ Tr	0.05/ Tr	0.05/ 1.9	0. 1/ 1.5	0.15/ 1.0	0.15/ 1.0

Table 13. Production, average percent utilization per plant, and pellet groups per acre on each of eight browse transects.

	1	2	3	4	5	6	7	8
Leaders/Acre								
Acgl	5,203		9,084					
Amal	68,843	35,060	9,728	1,495	26,310	14,128	8,122	7,768
Rosp				19,877				
Percent utilization								
Acgl	16.7		41.9					
Amal	18.7	49.2	43.7	64.4	46.1	41.4	39.9	30.8
Rosp				21.6				
Pellet groups/Acre								
Deer	261	937	762	1,742	762	1,307	1,503	1,416
Elk	44		87		65	22	65	

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Submitted by: John G. Mundinger

JOB TITLE: White-tailed deer movements, survival and population characteristics in the Clearwater River Drainage.[1]

ABSTRACT:

Collection of data pertaining to the population characteristics of the deer herd began in January 1976. A sex ratio count over the Christmas holiday was futile since weather conditions had not forced the deer to congregate in the Salmon Lake area at that time. Rough calculations following a strip census count in March show 415 deer are wintering on nearly 3.6 square miles. Preliminary counts in March and April indicate 85 fawns per 100 adults survived the winter; however, improper age classification may have occurred due to the size of fawns at this time of year. All adult doe reproductive tracts contained two fetuses; one fawn carried one fetus. Urine samples from a pregnant female and a hermaphrodite were run through a pregnancy test and showed positive and negative results, respectively.

Sixteen deaths were documented during the season. Two deer drowned, one died in a barbed wire fence, and one died of unknown causes. One death was a roadkill. Unfortunately, three deaths resulted from trapping. Two coyote kills were documented and six other deaths are suspected to be coyote kills. Several coyote stomachs were collected for later analysis. Blood samples were drawn from fourteen deer. Serum and whole blood was analyzed, and additional serum was frozen for later use in evaluating the condition of individual deer. Weights for fourteen deer were determined in the latter part of the winter.

Attemps at determining deer activity on the winter range were begun by establishing and running eleven browse transects and eleven snow courses. Seven rumen samples were collected. Sightings of 45 marked deer that were captured this winter have been plotted on maps.

On 2 May, general locations were determined from the ground on eight of nine radio-collared deer that began moving onto summer range. On 13 May, all nine deer were approximately located from the air with little movement indicated since 2 May. Seven of the nine deer are in the Placid Lake vicinity.

[1] This is an interim progress report of a graduate student study conducted in the Clearwater River Drainage of western Montana by Doug Janke of the University of Montana, Missoula.

Job Title Population ecology and habitat relationships of mule deer in the Bridger Mountains, Montana.

ABSTRACT

Population dynamics and habitat usage of mule deer on the Armstrong Winter Range in the Bridger Mountains, Montana during winter and spring 1976 are described and discussed in relation to previous studies on the area. A population of 170-175 mule deer present in early January 1976 remained static throughout winter and spring. This was approximately 20 percent more deer than were believed to have left the winter range in late May and early June 1975, but substantially fewer than used the area during 1973-74 and early winter 1974-75. Only two deer, both fawns, were known to have died during the 1975-76 winter. January 1976 classifications indicated much lower fawn:doe ratios than recorded in early winter of previous years. The overall male:female ratio indicated that proportionately fewer males, especially yearlings, occurred on the Armstrong area in 1975-76 than in previous years. Most deer observed from February through mid-May were on the "critical" winter range, an area comprised of steep south to west-facing slopes dominated by the *Purshia/Artemisia* and *Purshia/Agropyron* habitat types. Slightly greater usage of the *Festuca/Agropyron, Artemisia/Festuca,* and *Pseudotsuga/Carex* h.t. in 1976 than previously probably reflected the more open winter conditions which enabled deer to utilize a larger portion of the winter range. Marked deer generally showed the same pattern of habitat use as general observations though much variation occurred among the individual deer as well as between years for a given individual. Movements of all radio-marked animals which left the winter range in 1976 appeared to involve the same migration routes and "holding areas" as in 1975. Utilization of bitterbrush and big sagebrush declined significantly from 1974-75 to relatively light-moderate levels in 1975-76. This may have resulted from the generally more open winter, excellent growth and forage production, fewer deer on the winter range and/or very light use of the winter range by livestock in 1975-76.

Job Title — Population ecology and habitat relationships of mule deer in the Bridger Mountains, Montana.

Job Objective — To determine the environmental requirement of mule deer and factors regulating mule deer populations in mountain-foothill habitats of southwestern Montana.

To determine the effects of various potentially competing land use and management practices upon mule deer in southwestern Montana.

To develop new and improved guidelines for management of southwestern Montana mule deer populations and their habitats.

INTRODUCTION

Studies concerning population trends and dynamics and habitat relationships of mule deer in the Bridger Mountain Range have been conducted continuously since 1971. Initially, the effort was directed at (1) obtaining population data for mule deer on winter ranges along the west slope of the Bridger's from Bozeman to Flathead Pass (Fig. 1), with emphasis on the Armstrong Winter Range, (2) a study comparing food habits and range use of mule deer on the Armstrong Range during 1972 (Schwarzkoph 1973) with similar studies 15-years earlier (Wilkins 1957), and (3) a study of ecological characteristics of the Armstrong Winter Range, including production and utilization of preferred browse plants (Bucsis 1974). Hamlin (1974) further discussed summer distribution, movements, and population characteristics of mule deer associated with the Armstrong Range during 1973-74; and Mackie et al. (1976) and Pac (1976) extended these studies through the fall of 1975. Recently, Morton (1976) reported results of studies of nutritional values of major forage plants on the Armstrong Winter Range during 1974-75 and 1975-76. This report summarizes results of studies conducted on the Armstrong Winter Range during the winter-spring of 1976, with emphasis on population trends and characteristics as well as habitat usage in comparison with earlier findings.

ACKNOWLEDGMENTS

The studies have been conducted with the cooperation and assistance of Montana Department of Fish and Game, Region 3, U. S. Forest Service, Gallatin National Forest, and local landowners including Mrs. Elsie Armstrong, Mr. George Eblin, Mr. Claude Maher, Mr. Lloyd Maher, Mr. Lester Warwood, and Mr. Frank Norman. Murray Duffy, Central Helicopters, and James Stradley, Gallatin Flying Service, both contributed extensively through their flying and observational skills in helicopter and fixed-wing aerial surveys, respectively. Much credit is also due all of the many individual Montana Department of Fish and Game personnel and Montana State University graduate and undergraduate students who have

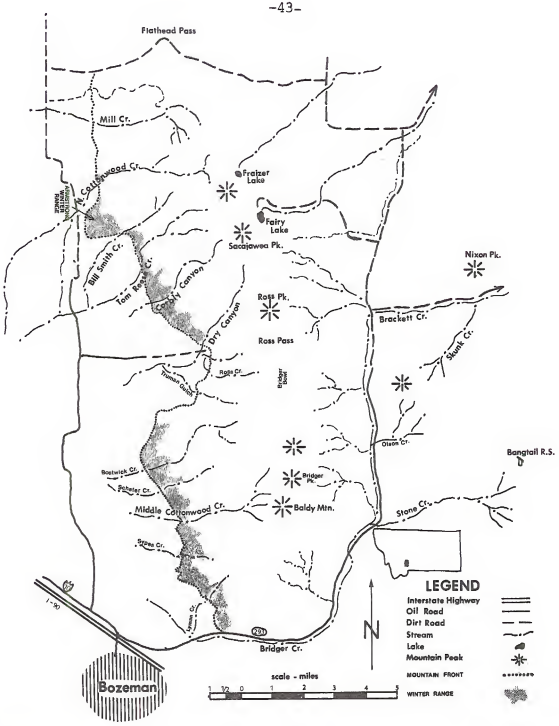

Figure 1. Map of the Bridger Range showing major features and location of the Armstrong Winter Range.

participated in one way or another in the studies. During the past year, the efforts of David F. Pac, Mary A. Morton, Lauren R. Spinney, and the M.S.U. Fish and Wildlife Forum contributed extensively to findings presented in this report.

Ground observations, trapping, and radio-tracking from February through early May were conducted primarily by Stewart.

STUDY AREA

The Bridger is located in northeast Gallatin County, Montana. The Armstrong Winter Range comprises approximately 1,260 acres, along a westerly projecting "toe" of the main Bridger Range approximately 20 miles north of the city of Bozeman (Fig. 1). Topographic, edaphic, climatic, and vegetational characteristics of the area have been described in detail by Bucsis (1974). A habitat type map and list of habitat types on the winter range (after Bucsis 1974) is presented as Figure 2.

METHODS

Mule deer population and range use characteristics were determined primarily through aerial surveys during early and late winter and ground observations associated with deer trapping and other studies on the Armstrong Range from February through early May.

The aerial surveys, employing a Bell 47G 3B-2 helicopter with the same pilot and principal observer as previous years (Mackie et al. 1976), were completed January 2 and March 15, 1976. Coverage included all mule deer wintering areas along the west slope. Locations, numbers, sex (in early winter) and age (adult or fawn) were recorded for all observations. In early winter, antler classes of males were also recorded. Elevations and habitat types used, as well as numbers, location and identifying markings of collared deer were also recorded.

Ground observations were recorded during a total of 56 days; 11 in February 25 in March, 14 in April and 6 in May. All mule deer were recorded as to number, age (adult or fawn), whether marked, specific markings, activity, location, habitat type, elevation, slope gradient, and exposure. Groups were recorded collectively, with locations marked precisely on aerial photograph-habitat type maps.

Additional marked deer were obtained by trapping, between February 21 and April 29. Specific trapping methods including the cannon net and a corral type bait trap have been described by Mackie, et al. (1975).

During 1976, a total of 36 mule deer were trapped, including 26 captures of previously marked animals and 10 new. Markers were four-inch-wide collars of Armor-tite fabric, color coded using tuff-flex marking paint, and fastened with blind rivets. Radio transmitter collars were fastened

Figure 2. Aerial view of the Armstrong Winter Range showing habitat types defined by Buscis (1974).

1. *Festuca idahoensis/Agropyron spicatum*
2. *Agropyron spicatum/Agropyron smithii*
3. *Purshia tridentata/Agropyron spicatum*
4. *Purshia tridentata/Artemisia tridentata*
5. *Artemisia tridentata/Festuca idahoensis*
6. *Acer glabrum/Philadelphus lewisii*
7. *Populus tremuloides-Prunus virginiana/Symphoricarpos albus*
8. *Juniperus scopulorum-Purshia tridentata/Artemisia tridentata*
9. *Juniperus scopulorum-Purshia tridentata/Agropyron spicatum*
10. *Juniperus scopulorum-Purshia tridentata/Festuca idahoensis*
11. *Pseudotsuga menziesii/Prunus virginiana*
12. *Pseudotsuga menziesii/Symphoricarpos albus*
13. *Pseudotsuga menziesii/Festuca idahoensis*
14. *Pseudotsuga menziesii/Carex geyeri*

to 9 deer, 5 males and four females. Four transmitters applied in 1975 continued to function through most of the winter into spring. As deer left the winter range in early May, radio-collared deer were followed by approximately weekly relocations using receiving equipment from a fixed-wing, Piper Supercub Aircraft.

A systematic "dead deer survey" of the winter range between North Cottonwood and Bill Smith Creeks was conducted in mid-May. The survey employed project personnel and Montana State University students and followed procedures similar to those employed in May 1975. Browse utilization transects, 8 on bitterbrush *(Purshia tridentata)* and 5 on big sagebrush *(Artemisia tridentata)*, established by Bucsis (1974), were remeasured in late May. Methods followed those of Bucsis (1974) and included estimates of percentage of current growth twigs utilized and length and weight of current annual growth removed.

RESULTS AND DISCUSSION

The 1975-76 Winter

Monthly weather data and winter severity indices (Picton and Knight 1969) for the Montana State University Weather Station at Bozeman (Table 1) compare November-May conditions from 1971-72 through 1975-76. Although located approximately 15 air miles south of the winter range this station is only slightly lower in elevation and conditions may be reasonably representative of general conditions along the west slope of the Bridger Mountains.

These data indicated that the 1975-76 winter was characterized by relatively mild temperatures and light snowfall, and was generally much less severe and prolonged as compared with 1974-75. Overall it also was generally less severe than any preceding winter except 1971-72.

Phenological data, based on lilac bloom dates for the Bozeman area (Caprio 1975) indicated that "spring" conditions and plant growth were more than two weeks ahead of normal during 1976. During 1975, snowmelt and plant phenology were approximately two weeks behind "normal" (Pac 1976).

Population Size and Trend

Population estimates for mule deer using the Armstrong Winter Range during the 1975-76 winter (Table 2) were developed from aerial and ground observations during January, March, and April, 1976. An early January estimate of approximately 178 deer was derived as a Lincoln Index (Overton and Davis 1969) from data obtained during the January 2 helicopter survey. A total of 121 mule deer, including 32 of 47 collared deer believed present at the time, was observed and classified during that flight. March and April estimates of 177 and 168 mule deer, respectively, were derived as Schnabel (Overton 1965) indices. These calculations employed cumulative observations of unmarked and collared animals for 20 intensive ground surveys during March and 3 during April. Between 49, (early March) and 55, (early April) collared deer were known to be present.

Table 1. Climatological data, MSU Weather Station, Bozeman, and severity indices, November through May, 1971-1976.

		Ave. Temp. (°F)	Ppt. (in.)	Total Snowfall (in.)	Max. Snow Depth (in.)	No. Days Snow on Ground	Severity[1] Index
November	1971	33.7	0.77	11.2	5	17	- 297
	1972	32.8	0.63	3.0	4	8	- 250
	1973	30.4	1.27	15.8	11	25	+ 104
	1974	35.1	0.67	4.7	2	10	- 377
	1975	30.5	1.33	20.5	12	15	+ 491
December	1971	20.8	0.56	11.1	10	31	+1161
	1972	18.6	0.49	12.2	4	23	+1047
	1973	29.5	1.29	20.5	13	16	+ 234
	1974	25.5	1.02	13.2	6	31	+ 284
	1975	30.0	1.10	15.8	6	22	+ 84
January	1972	19.1	0.86	13.8	10	31	+1068
	1973	19.2	1.10	16.6	9	31	+1837
	1974	21.3	0.42	5.8	14	25	+3743
	1975	22.8	1.58	22.9	14	31	+1369
	1976	26.6	0.60	8.7	9	28	+ 360
February	1972	31.0	0.66	10.2	6	27	- 75
	1973	24.4	0.04	1.8	8	28	+ 483
	1974	32.0	0.43	7.8	4	21	- 206
	1975	21.3	1.11	19.5	17	28	+1659
	1976	30.4	0.52	9.8	4	5	- 187
March	1972	41.0	1.24	13.6	8	8	- 586
	1973	33.9	1.89	23.0	11	31	- 303
	1974	32.6	1.71	24.7	7	26	- 206
	1975	29.1	1.08	20.7	9	31	+ 295
	1976	28.7	1.03	18.5	6	12	+ 262

Table 1. Continued.

		Ave. Temp. (°F)	Ppt. (in.)	Total Snowfall (in.)	Max. Snow Depth (in.)	No. Days Snow on Ground	Severity Index
April	1972	41.3	1.91	21.9	4	5	- 652
	1973	38.9	2.84	34.7	14	14	- 520
	1974	45.8	1.87	3.2	0	0	- 764
	1975	32.9	1.77	16.1	8	24	- 141
	1976	43.4	3.35	21.9	4	4	- 663
May	1972	50.7	1.73	trace	1	0	- 958
	1973	51.4	1.44	1.3	trace	0	- 989
	1974	48.3	3.00	12.1	3	3	- 880
	1975	46.9	4.88	21.5	9	6	- 803
	1976	55.5	1.95	trace	0	0	-1157
Nov.- May	1971-72	33.9	7.7	81.8	10	119	- 329
	1972-73	31.3	8.4	92.6	14	135	+1335
	1973-74	34.3	10.0	89.9	14	116	+2025
	1974-75	30.5	12.1	118.6	17	161	+2286
	1975-76	35.2	9.9	95.2	12	86	- 810
20 Year Ave.		32.4	9.5				

[1]+ Values indicate greater severity.

Table 2. Estimates of numbers of mule deer on the Armstrong Winter Range, Bridger Mountains, 1975-76.

	Estimated Numbers						
Date	Tot.	Adults	Fawns	Fem.	Male	Yrlg. Male	Remarks
Jan.	178	166	12	124	39	3	Lincoln Index 1/2 helicopter survey and classification
Mar.	177	161-164	13-16	-	-	-	Schnabel Index 20 ground surveys and 8/10 fawns:100 ad.
Apr.	168	153-156	12-15	-	-	-	Schnabel Index 3 ground surveys and 8/10 fawns:100 ad.

Cumulatively, these data indicated that approximately 170-175 mule deer occurred on the Armstrong Range during 1975-76. This was about 20 percent more deer than were believed to have left the winter range in late May and early June 1975 (Mackie et al. 1976), but substantially fewer mule deer than used the area during 1973-74 and in early winter 1974-75. Mackie et al. (1976) estimated that about 230 deer probably occurred on the area in the spring of 1974 and that approximately 210 were present in January 1975.

The increase of 20 percent (about 30 deer) on the area from the late spring of 1975 to the 1975-76 winter was not consistent with fawn production and survival from June 1975 through May 1976. Pac (1976) reported observations of only 25 fawns:100 does and 27 fawns:100 does on and adjacent to the Armstrong Range during October and November 1975, respectively, decreasing to about 11 fawns:100 does on the winter range in December. Aerial and ground classifications through the winter (Table 3) indicated similarly low or lower ratios and that a maximum of 10-12 fawns probably occurred on the area by late winter. This was not adequate to replace known or probable losses from the time deer left the range in 1975 through the spring of 1976. At least 7 of 55 neck-banded animals which left the winter range in June 1975 either were not on the winter range or could not be accounted for during the winter of 1976. At least one of these was known to have wintered elsewhere and two were among the four deer known to have been killed on the study area during the fall of 1975 (Pac 1976). Trapping has also shown that some collars may be lost.

Since fawn production could not account for the increased deer numbers present in 1975-76, either the estimates were grossly in error, some immigration of unmarked animals from other areas occurred, or unmarked animals wintering immediately adjacent to the east of the Armstrong Range were included in our observations more frequently in 1975-76 than in 1974-75 and previous years. Both the first and second possibilities seemed unlikely. Our trapping efforts have maintained relatively high percentages of the population (25-35 percent) marked; and Lincoln-Schnabel indices were based on the best and most intensive surveys made through the winter. They frequently included well over 100 animals in a daily observation period with reasonable certainty as to identification of marked individuals. Secondly, past movements data (Pac 1976) have indicated that yearlings and younger animals, especially males, would be most likely to move great distances and change home ranges between years. When January classifications were applied to the population estimate for that period, the population would have included only three yearling males and total numbers and proportions of males using the area appeared to have declined slightly. On the other hand, it is likely that some unmarked deer or groups of deer, which normally winter south of Bill Smith and/or Tom Reese Creeks and which may include one or two marked deer, spent more time north of Bill Smith Creek in 1975-76. With little snow accumulations and generally mild conditions prevailing, the deer were able to move more freely and widely than during 1974-75. Several animals, including marked individuals frequently ranged to the north side of North Cottonwood Creek or even further in 1975-76; something which did not occur during most of

Table 3. Sex and age classification of mule deer on the Armstrong Winter Range, Bridger Mountains, monthly summaries, January - May 1976.

Month	Source	Total Number						FF:100	FF:100	MM:100
		Observed	Classified	Adult	Fawn	Female	Male	Female	Adult	Female
January	Helicopter survey	121	121	113	8	84	29	10	7	35
February	Ground	378[1]	322	309	13	-	-	-	4	-
March	Helicopter survey	102	102	90	12	-	-	-	13	-
March	Ground	1,886	1,659	1,600	59	-	-	-	4	-
April	Ground	1,247	1,053	1,018	35	-	-	-	3	-
May	Ground	353	275	271	4	-	-	-	1	-

[1]Number for ground observations are cumulative monthly totals observed and classified.

the previous winter. Because of this, it seems reasonable to conclude that the 1975-76 winter population estimates probably were inflated due to occasional if not persistent use of the Armstrong area by unmarked animals which in past years spent most of their time elsewhere, particularly south of Bill Smith Creek. However, greater trapping effort along the south boundary of the area will be required in further years to evaluate this factor and measure the possible degree of error associated with it.

Sex and Age Population Composition

Estimated numbers of adults, adult females, adult males, yearling males, and fawns associated with the early January population estimate and numbers of adults and fawns associated with March and April estimates were shown in Table 2. Various helicopter and monthly ground classification totals and fawn:female, fawn:adult, and male:female ratios derived from them for 1975-76 are listed in Table 3. January and March aerial classifications are compared with those of previous years in Table 4.

These data indicate that proportionately fewer males, especially yearlings, occurred on the Armstrong area in 1975-76 than in previous years. Only 2 evident yearling males, both spike-antlered, were recorded in the January flight. No yearling males and only one yearling female were included among the 36 deer handled in traps. This was expected in view of the loss of 85-90 percent of all fawns during the 1974-75 winter, when only 3-4 fawns were believed to have survived on the area. The overall male: female ratio (35:100) was only slightly lower than the 39 males:100 females recorded in 1973-74.

The 10 fawns:100 does recorded in January 1976 was considerably below ratios recorded in early winter of previous years, as was the fawn:adult ratio. The late winter (March) classifications indicated equal or greater proportions of fawns at that time in 1976 as compared with 1975, though again these ratios remained lower than in previous years (Table 4). Cumulative ground observations for February, March, April, and May all indicated relatively low fawn ratios as compared with aerial classifications, but may have been biased against fawns which occurred mainly among two or three small groups of deer on the area; including one group at least which spent considerable time in the vicinity of North Cottonwood Creek where relatively few observations were made. Overall, observations and data indicated that no more than 12-15 fawns probably occurred on the area in early January and perhaps only 8-12 by March and April. In marked contrast to most years, no fawns were included among the animals captured in trapping. Also, only two fawns were observed to have died (carcasses located) during the winter, supporting the relatively high survival of fawns through the winter indicated by classifications.

It seems likely that the very low fawn production and/or survival indicated by these data for 1975-76 reflected after effects of the extremely severe 1974-75 winter on fawn production. However, as indicated earlier, Pac (1976) also recorded a sharp decline in fawn:doe ratios between fall and early winter 1975, suggesting that some mortality of fawns had occurred

TABLE 4. AERIAL CLASSIFICATIONS OF MULE DEER ON THE ARMSTRONG WINTER RANGE, JANUARY 1972 THROUGH APRIL 1976.

		NUMBERS							RATIOS			PERCENTAGES		
		Total Count	Total Class.	Adults	Males	Females	Fawn	Uncl.	F:100 Females	F:100 A	Males:100 Females	% Fawn	% Ylg Males	% Spike Ylg Male
Reese Cr. - N. Cttnwd.	1971-72 Jan. 3	173	173	119	39	80	54	-	68	45	49	31	56	26
	Mar. 28	92	83	68	-	-	15	9	-	22	-	18	-	-
	1972-73 Feb. 7	188	188	143	-	-	55	-	-	31	-	24	-	-
	1973-74 Dec. 27	131	131	100	28	72	31	-	43	31	39	24	46	62
	Apr. 1	188	188	154	-	-	34	-	-	22	-	18	-	-
	1974-75 Jan. 5	140	140	116	37	79	24	-	30	21	47	17	19	17
	Mar. 23	227	227	214	-	-	13	-	-	6	-	6	-	-
	Apr. 20	99	99	96	-	-	3	-	-	3	-	3	-	-
	1975-76 Jan. 2	121	121	113	29	84	8	-	10	7	35	7	7	100
	Mar. 15	102	102	90	-	-	12	-	-	13	-	12	-	-

in late November. Whether this reflected a lag effect of the prior winter on fawn condition and survival or was the direct effect of some other range condition factor as suggested by Pac, or still some other factor is unknown. In any event, it appears that a further decline in adult numbers on the Armstrong area can be expected into the 1976-77 winter, with minimal recruitment from a small 1975 fawn crop surviving to 1976.

Over-winter Mortality

Recorded winter losses for 1975-76 in comparison with those located during the four winters from 1971-72 through 1974-75 are listed in Table 5 together with the age composition of carcasses examined in all years. Some additional, unrecorded mortality also was evident in most years. On the basis of indices derived from a late winter dead-deer survey, and population-age composition data, the total 1974-75 mortality was estimated at approximately 70 deer. This included about 22 percent of the adults, 85-90 percent of all fawns, and 30-35 percent of all deer present on the Armstrong range in early winter. Changes in fawns:adult ratios through winter in the earlier years suggested 20-50 percent fawn mortality from 1971-72 through 1973-74.

Data for 1975-76, cumulatively, indicated that total mortality on the winter range was extremely light. Only two carcasses identified as current winter losses were located. Both were fawns. Three carcasses not previously located were found during the mid-May, dead-deer survey; but all appeared to have died prior to the current winter. One additional deer, a mature male, died as a result of a trapping accident. The lack of any change in observed fawn:adult ratios through the winter was also indication of very little if any over-winter mortality among fawns. No marked adults were known to have died.

Population data, generally, together with relocations of a high proportion of deer collared in past years, indicated that mortality or turnover of adults was extremely low from the spring of 1975 to the spring of 1976. This probably reflected the heavy loss of vulnerable young and old animals during the 1974-75 winter; thus, few were available to be lost during 1975-76.

Habitat Use

Frequencies of mule deer use of the various habitat types on the Armstrong Range by monthly periods from February through May 1976 are presented in Table 6 together with comparable data for 1975. Percentage use of various types by individually marked deer observed during both 1975 and 1976 is compared in Table 7.

Generally, these data indicate that the general pattern of habitat type usage reported earlier by Wilkins (1957), Schwarzkoph (1973) and Mackie et al. (1976) continued during 1975-76. This was despite occurrence of fewer deer on the winter range and the relatively mild and open winter

Table 5. Number and age classes of winter-killed mule deer found on the Armstrong Winter Range 1971-1976.

Year	Number				
	Total	Fawns	Yrlg.	Prime	Old
1971-72	19	9	-	-	10
1972-73	18	12	-	1	5
1973-74	12	10	-	-	2
1974-75	42	16	2	10	14
1975-76	2	2	-	-	-

Table 6. Comparison of use of habitat types by mule deer on the Armstrong Winter Range during winter and spring 1975 and 1976. Data for 1975 are from Mackie et al. (1976).

Month	Habitat Type[1]													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Feb.	1/9[2]	2/-	25/5	50/48	1/16	-/-	-/-	7/-	10/-	2/Tr[3]	-/-	Tr	1/5	-/15
March	1/6	-/2	40/25	48/49	1/8	-/-	-/-	Tr/3	3/Tr	6/Tr	-/-	-/-	1/-	-/6
Apr.	3/6	8/-	25/38	42/38	1/10	-/-	-/-	1/Tr	10/-	10/Tr	-/-	-/Tr	Tr/-	-/7
May	2/33	15/-	23/3	37/16	16/30	-/-	-/-	1/-	Tr/-	1/-	Tr/-	-/5	-/-	4/13

[1] 1. *Festuca idahoensis/Agropyron spicatum*
2. *Agropyron spicatum/Agropyron smithii*
3. *Purshia tridentata/Agropyron spicatum*
4. *Purshia tridentata/Artemisia tridentata*
5. *Artemisia tridentata/Festuca idahoensis*
6. *Acer glabrum/Philadelphus lewisii*
7. *Populus tremuloides-Prunus virginiana/Symphoricarpos albus*
8. *Juniperus scopulorum-Purshia tridentata/Artemisia tridentata*
9. *Juniperus scopulorum-Purshia tridentata/Agropyron spicatum*
10. *Juniperus scopulorum-Purshia tridentata/Festuca idahoensis*
11. *Pseudotsuga menziesii/Prunus virginiana*
12. *Pseudotsuga menziesii/Symphoricarpos albus*
13. *Pseudotsuga menziesii/Festuca idahoensis*
14. *Pseudotsuga menziesii/Carex geyeri*

[2] Data are percentages of the total mule deer observed which were recorded on each type during the month, 1975/1976, respectively.

[3] Tr - Trace = less than 0.5 percent.

Table 7. Comparison of habitat type usage by individually marked mule deer on Armstrong Winter Range, winter-spring 1975 and 1976.

Animal No.	No. Obs.	Year	Habitat Type No.[1]										
			1	2	3	4	5	8	9	10	11	12	14
3-72/	8	75	12[2]	–	12	75	–	–	–	–	–	–	–
Female	29	76	10	–	7	76	3	–	–	–	–	–	3
1-73/	19	75	5	32	11	47	5						–
Female	19	76	–	11	11	31	42						5
2-73/	14	75	–	7	7	71	7	–	–	7			
Female	12	76	–	–	17	83	–						
9-73/	9	75	–	11	11	78	–						
Female	26	76	8	–	15	65	12						
22-74/	16	75	–	–	69	31	–						
Female	14	76	–	–	64	36	–						
32-74/	15	75	–	13	40	7	27	13					
Male	15	76	–	27	27	13	7	27					
1-75/	20	75	–	10	40	40	–	5					5
Female	26	76	–	–	58	35	–	8					–
3-75/	13	75	–	–	61	–	23	8	–	8	–	–	–
Female	12	76	–	–	42	8	25	–	–	8	–	–	17
11-75/	18	75	–	11	33	6	39	6	–	–	6		
Male	9	76	–	11	44	11	–	11	–	–	–	–	22
16-75	14	75	–	21	36	36							7
Female	15	76	–	7	47	40							7
17-75/	15	75	–	20	7	47							27
Female	16	76	–	–	44	56							–
24-75/	7	75	14	14	14	57						–	–
Female	16	76	–	–	31	37	19	–	–	–	–	7	7
25-75/	16	75	–	19	37	44							–
Female	25	76	–	4	48	44							4

Table 7. Continued

Animal No.	No. Obs.	Year	Habitat Type No. 1	2	3	4	5	8	9	10	11	12	14
28-75/	9	75	11	–	–	89	–	–	–				
Female	13	76	–	–	31	54	15	–	–				
31-75/	6	75	31	–	17	50	–	–	–	–	–	–	–
Female	39	76	10	3	13	56	15	–	3	–	–	–	–
33-75/	9	75	11	–	–	78	–	–	–	11	–	–	–
Female	27	76	4	–	18	44	26	–	–	4	–	4	–

[1]See Figure 2 and/or Table 6 for habitat type designations.
[2]Data are percentage of all relocations which were recorded on each type, February-May, each year.

conditions as compared with 1974-75. Total observational data suggested slightly greater usage of the *Festuca/Agropyron, Artemisia/Festuca,* and *Pseudotsuga/Carex* types, especially with the onset of spring, during 1976 as compared with 1975; and somewhat less use of the *Agropyron* and *Juniperus/Purshia/Festuca* types, but the latter is extremely limited in extent on the area.

Greater usage of the *Festuca, Artemisia,* and *Pseudotsuga* types listed above reflected the more open conditions which enabled deer to range slightly higher, further north, and down onto flats at the base of winter range slopes throughout the winter and especially in late April and May as greenup got underway and progressed.

Although marked deer generally showed the same overall pattern of habitat use as general observations, much variation occurred among the individual deer as well as between years for a given individual (Table 6). Apparently habitat selection and use by individual deer varies greatly and may be controlled by factors other than those affecting patterns of selection and use by the population as a whole.

Habitat usage as well as the location of observations indicated that mule deer ranged more widely; including, as noted above, higher on slopes, further north to slope of North Cottonwood Creek and beyond, and occasionally onto the flats. There was some indication that deer on the southeastern edge of the winter range, in the vicinity of Bill Smith and Tom Reese Creeks frequently ranged on and off the area. However, distributional differences were slight on the overall data and difficult to quantify, at least in analyses completed to date.

Mule deer usage of flats well away from the winter range during spring was very limited in 1976; with few deer observed to move regularly on and off the slopes to forage as greenup occurred. Deer were not observed to use the fields south of the Armstrong Ranch or west of the Reese Creek-Pass Creek Road, in contrast to previous years.

Spring Dispersal Movements

Weekly relocations of 13 radio-collared deer from early May through June provided data on rate and patterns of movements off the winter range in 1976 as compared with 1975 (Pac 1976). Although all of these deer remained within winter range boundaries on May 5, several had moved higher and toward the northeast and southeast. By May 13, the four radio-collared deer which Pac (1976) followed from the winter range in 1975 had moved to the same places where they were located on June 13, 1975, as dispersal began. Subsequent relocations of these four deer, all adults females, showed that all moved to the same summer ranges used in 1975 by the end of the first week in June.

Among the other deer, an adult male, observed on the winter range on May 17, was observed moving northeast on May 21 and May 26; and, by

May 30 was on its summer range along the Bridger Range Divide. Three other deer moved to the east slope, include an adult male, a mature female, and a two-year-old female. All three remained on the winter range through May 21; and the mature male and female had not yet moved on May 26. The young doe could not be located; but on May 30 was on her summer range northeast of Frazier Lakes. On June 8, both the adult male and female were similarly on summer range in the Frazier Lake Area along the east slope. By the end of June, 5 of the 13 radio-collared deer remained in the vicinity of the winter range.

Movements of all radio-marked animals which left the winter range appeared to involve use of the migration routes and "holding areas" described by Pac (1976).

Forage Utilization and Trend

Utilization data for antelope bitterbrush *(Purshia tridentata)* and big sagebrush *(Artemisia tridentata)* among several transects located on major habitat types within the primary winter range during 1975-76 and trends over the past four winters are presented in Table 8. These data indicate that utilization of both species declined significantly from 1974-75 to relatively light-moderate levels in 1975-76.

Although the percentages of current annual growth twigs (CAGT) or "leader" remained moderately heavy among bitterbrush plants and transects, total utilization by length and weight declined very significantly from 1975 to 1976. Generally, percentages of CAGT used declined more for big sagebrush than for bitterbrush, though use remained high on two transects located on particularly heavily used sites on the center of the winter range. Total utilization by length and weight was extremely light (less than 5 percent) on three of the four big sagebrush transects and only 8-11 percent on the fourth.

Decreased utilization during 1975-76 may have resulted from several factors; including the generally open winter with only light and sporadic snow cover on much of the winter range; excellent growth and forage production by both bitterbrush and big sagebrush as well as other forage plants on the winter range during 1975; generally fewer deer on the winter range than previous years; and only very light use of the principal winter range by livestock in 1975-76. Rather heavy cattle use occurred on much of the winter range in fall and early winter 1974-75.

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Table 8. Utilization of antelope bitterbrush and big sagebrush on the Armstrong Winter Range, 1972-73 through 1975-76.

ANTELOPE BITTERBRUSH

		Transect Number							
	Year	T-2	T-3	T-4	T-5	T-8	T-15	T-18	Ave.
	1972-73[1]	-	83	80	85	84	78	88	84
	1973-74[1]	90	89	-	90	89	74	90	86
Percent	1974-75	85	89	83	90	86	85	85	87
CAGT used	1975-76	78	64	37	79	61	44	52	52
	1972-73	-	44	50	60	62	57	61	57
	1973-74	61	68	-	57	56	53	57	58
Percent	1974-75	74	87	58	83	88	68	67	66
Lgth Utiliz.	1975-76	16	17	17	22	31	28	21	19
Percent	1974-75	76	85	57	79	64	54	55	59
Wt. Utiliz.	1975-76	7	8	7	17	25	26	18	13

BIG SAGEBRUSH

		Transect Number					
	Year	T-2	T-3	T-4	T-5	T-8	Ave.
	1972-73	-	68	85	87	89	81
	1973-74	77	72	-	89	90	84
Percent	1974-75	71	76	82	86	87	83
CAGT used	1975-76	15	15	6	49	57	28
	1972-73	-	28	33	38	51	39
	1973-74	42	34	-	46	51	44
Percent Lgth.	1974-75	52	58	68	60	73	62
Utiliz.	1975-76	2	2	2	-	8	3
Percent	1974-75	61	65	76	72	81	71
Wt. Utiliz.	1975-76	3	3	3	-	11	4

[1]1972-73 and 1973-74 data from Bucsis (1974).

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Submitted by: R. J. Mackie

Shawn T. Stewart

JOB TITLE: Distribution, movements and habitat use during spring, summer and fall by mule deer associated with the Armstrong winter range, Bridger Mountains, Montana[1/]

ABSTRACT:

A study was conducted in the Bridger Mountains of southwestern Montana from June through September 1974 and from June through December 1975. Objectives were to obtain data on summer and fall distribution, movements, habitat use and food habits, including nutritional relationships, of mule deer associated with the Armstrong winter range. Special emphasis was directed to use of forest habitat types by monitoring five radio-collared adult females. Fourteen habitat types and five phases associated with five major climax series were recognized and described. Deer numbers, productivity, distributions, movements, and range use characteristics were determined from 22 aerial flights and regular ground surveys. Approximately 210 deer occurred on the Armstrong Range in early winter 1975, of which only 139 survived the severe winter and dispersed onto summer ranges in the spring of 1975. Observed fawn:doe ratios declined from 26:100 in early fall 1975 to 9:100 by early winter, with most of the change occurring during a period of severe weather in late November when deer were concentrated on fall "holding" areas. Relocations of individually marked animals showed that 73 percent had summer and/or fall ranges within 6 kilometers of the winter range. The remainder migrated greater distances north and south of these areas as well as along the east slope of the Bridger Range. Most deer appeared to habitually use the same summer and winter home ranges each year. Seasonal migrations followed definite routes which included local "holding" areas where deer aggregated for variable time periods during spring and fall. Normal summer home ranges averaged 52 hectares (128 acres) for the five radio-collared females, while total home ranges averaged 107 hectares (264 acres). Heavy usage of forested habitats, especially the *Pseudotsuga menziesii* series, was observed during late spring, summer, and fall 1975. The DF/Caru, DF/Cage, and DF/Agsp habitat types were most important during spring and fall. The DF/Caru and Krummholz types were most important in summer. Relocations of radioed deer indicated that use of *Pseudotsuga menziesii* series may have been overestimated by general observations while usage of *Abies lasiocarpa* and *Pinus albicaulis* series were underestimated. Significant shifts in use of habitat types occurred during late summer, apparently in response to shortages of succulent forage caused by dessication and killing frosts. Food habit studies showed that forbs and browse, in order of importance, were used during late spring (June): while forbs, browse, and grass and browse, forbs, and grass were orders of importance for use during summer and fall, respectively. Protein contents of important forage plants were highest at emergence in spring and declined steadily to fall dormancy.

[1/] This abstract is from the Master's Thesis of David Pac, Montana State University, Bozeman, from a study in the Bridger Mountains of southwestern Montana. The final report of this study was published separately earlier in the report period.

JOB TITLE: Nutritional values of important mule deer winter forage plants in the Bridger Mountains, Montana.[1/]

ABSTRACT:

Nutritional parameters of major mule deer winter forage species and maximum potential forage production of herbaceous plants were evaluated within each of four different habitat types of the west slope of the Bridger Mountains in southwestern Montana. Habitat types sampled were: *Agropyron spicatum/Festuca idahoensis* h.t., *Purshia tridentata/Agropyron spicatum* h.t., *Purshia tridentata/Artemisia tridentata* h.t., and *Artemisia tridentata/Festuca idahoensis* h.t. Six major forage species, big sagebrush, bitterbrush, arrowleaf balsamroot, common salsify, Idaho fescue and downy chess brome were sampled during early, mid, and late winter during 1974-75 and early and mid-winter 1975-76. In addition, samples were taken of Rocky Mountain juniper, chokecherry, nootka rose and Douglas fir. Big sagebrush had the highest protein content of the browse species, 9.8 percent during the winter of 1974-75 and 9.4 percent in 1975-76, while nootka rose had the least, 5.2 percent in 1974-75 and 5.4 percent in 1975-76. Arrowleaf balsamroot had the highest protein content of the herbaceous species, 6.3 percent in 1974-75 and 5.8 percent in 1975-76, while downy chess brome had the least, 2.6 percent in 1974-75 and 4.0 percent in 1975-76. Big sagebrush had the lowest crude fiber level, approximately 17.0 percent during both winters. Downy chess brome had the highest crude fiber content, approximately 40 percent during both winters. The evergreen species, big sagebrush, juniper, and Douglas fir, had the highest content of crude fat during both winters and downy chess brome had the least. Arrowleaf balsamroot had the highest level of ash content during both winters and also contained the greatest amounts of calcium during 1975-76, 2.61 percent. Chokecherry and juniper were also high in calcium content (1.53 and 1.04 percent, respectively). Several significant differences were found in nutrient levels of certain species from different habitat types. Significant variations from year to year were also noted. Four herbaceous species provided an estimated total of 104,095 kilograms of plant matter within the combined areas of the four habitat types at the onset of winter in 1975. Arrowleaf balsamroot was the most abundant species in three of the four habitat types, accounting for 65 percent of the total production. Idaho fescue was most abundant in one type, comprising 28 percent of the total. Downy chess brome and common salisfy provided 6 percent and 2 percent of the total, respectively.

1/ This is the abstract of the Master's Thesis by Mary Morton, Montana State University, Bozeman, from a study in the Bridger Mountains of southwestern Montana. The final report of this study was published separately during the report period.

Job Title Mule deer population ecology, habitat relationships, and relations to livestock grazing management and elk in the Missouri River Breaks, Montana.

ABSTRACT

Population trends and dynamics in a mule deer population in the Missouri Breaks from 1960 through 1975 are discussed. Basic population data were obtained during intensive full-time studies from 1960-64 on a representative 100-square mile study area in the Missouri River Breaks, approximately 25 miles northeast of Roy in Fergus County. From 1963-64 through 1967 and 1970 through 1975-76, data were obtained primarily through intensive early winter aerial (helicopter) surveys covering all parts of the study area. These data provided estimates of early winter population size and trend and sex-age composition through the 16-year study period. Subsequent calculations provided estimates of annual turnover and fawn survival. The mule deer population declined from 1960 to 1961, recovered partially by 1963-1964, declined sharply to 1965-1966, increased consistently from 1967 to 1970 at a rate of about 12 percent per year, then declined again to 1975-76. Major decreases amounted to about 20 percent between the winters of 1960 and 1961, 30 percent from 1964 to 1965, and 50 percent from early winter 1971 to the winter of 1972. The total decline from 1970 to 1975-76 was 64 percent from a "peak" population in 1970 similar to that estimated for 1960-61. Annual turnover data indicated that approximately 30-33 percent of all mule deer present on the study area in early winter one year would be lost by the following year. This included 25-27 percent of all females and 46-47 percent of all males. Above average turnover was associated with downward population trends, particularly those associated with periodic severe environmental conditions, lowest rates generally occurred in years immediately following the highest rates. Although rates generally held under both high and low hunter pressures and harvest, the female turnover rate for 1974 to 1975 decreased by more than 50 percent when the area was closed to either sex hunting in 1975. Fawn production and survival together with periodic, "catastrophic" mortality associated with severe environmental conditions were major factors influencing population trend. It appeared that fawn crops of 30-33 percent of the early winter population were required to maintain a stable population from one year to the next, baring no unusual late winter mortality. Population increases were associated with higher percentages and ratios above 55-60 fawns per 100 females (40 fawns:100 adults) and sharp declines with ratios at or below 40 fawns:100 females or 30 fawns:100 adults.

Job Title — Mule deer population ecology, habitat relationships, and relations to livestock grazing management and elk in the Missouri River Breaks, Montana.

Job Objective — To further determine the environmental requirements of mule deer and factors regulating mule deer populations in the "breaks" type of eastern Montana.

To further determine the direct and indirect effects of livestock grazing management under rest-rotational and continuous grazing systems upon deer populations and habitat relationships and upon deer-elk interrelationship in the "breaks" type.

To develop new and improved guidelines for management of mule deer populations and their habitats in the "breaks" type of eastern Montana and for consideration of deer habitat requirements in elk, livestock, and range management programs in this type.

INTRODUCTION

River "breaks" and rough uplands dominated by ponderosa pine *(Pinus ponderosa)* and Rocky Mountain juniper *(Juniperus scopulorum)* represent the most important habitat of mule deer *(Odocoileus hemionus)* over much of central and eastern Montana. Particularly important mule deer populations occur in the breaks of the Missouri River in northcentral Montana from the mouth of the Judith River east to Fort Peck.

In 1960, an intensive study of mule deer and their relationships to elk *(Cervus canadensis)* and domestic livestock was established on a representative 75,000-acre area in the Missouri River Breaks approximately 25 miles northeast of Roy (Mackie 1970). Habitat use and population studies were conducted concomitantly from June 1960 through September 1963 and intermittently from October 1963 through May 1964. From the summer of 1964 through the spring of 1975, less intensive studies were continued on the area primarily to obtain population data for mule deer. In July 1975, intensive studies resumed under the statewide deer research program to further evaluate factors regulating mule deer populations in the breaks habitat type of eastern Montana.

Mackie (1970) presented historical information on mule deer in the "Breaks", discussed development of the existing population from the late 1930's through the early 1950's, and described trends in numbers, sex and age composition, and harvest from 1960 through winter-spring 1964. Subsequent reports (Mackie 1966, 1973) extended these data through early winter 1965-66 and 1972-73, respectively. All population data obtained from 1960 through 1975 are now being compiled and analyzed as a basis for further detailed studies of factors influencing mule deer population trends in the Breaks habitat under the statewide deer research program. This report summarizes data

compiled to date concerning population trends and dynamics of mule deer on the study area over the 16-year, 1960-1975 period. A complete report of these data and factors influencing population dynamics will be forthcoming as analyses are completed.

ACKNOWLEDGMENTS

The study was conducted in part on the Charles M. Russell Wildlife Range administered by the U. S. Department of the Interior, Fish and Wildlife Service and adjacent public lands, administered by the U. S. Bureau of Land Management. It was supported from 1960 through 1965 under Montana Federal Aid Project W-98-R, and from 1966 through 1975 under Federal Aid Projects W-74-R, W-130-R, and W-120-R. The Fish and Wildlife Service and Bureau of Land Management both contributed helicopter flight time in some years. The C. M. Russell Wildlife Range also provided facilities from which aerial surveys were conducted from 1970 through 1975. Many individuals within the Montana Department of Fish and Game contributed greatly to the studies through the years; and without the support and assistance of Region 4 Game Manager, Jim Mitchell and Area Game Management Biologists, Neil Martin and Robert Watts the study may not have continued beyond 1966. Credit is also due Murray Duffy, helicopter pilot, whose flying and observation skills contributed greatly to the quality of data obtained in annual aerial surveys from 1963 through 1975-76.

METHODS

From 1960 through 1963, basic population data were obtained primarily by ground observations during morning and evening periods along 11 vehicle observation routes which encompassed all portions of the study area. Supplementary data were obtained through aerial (helicopter and fixed-wing aircraft) surveys during May-June, September-October, and December of most years. All mule deer observed along routes and during aerial surveys were classified with respect to sex, age (fawn, adult and/or adult female, adult male, yearling male), and number of young per female whenever possible.

From 1964 through 1967 and 1970 through 1975, population data were basically obtained in annual early winter (December-January) intensive helicopter (Bell 47G 3-B2, 280 HP) surveys of the study area (Table 1, Appendix Table 1).

The same pilot and principal observer were involved in all of the surveys except 1967, when only the Sand Creek drainage was flown for general classifications, and 1973, when unfavorable conditions delayed the survey until early March and again only portions of the area were flown. A third observer-recorder present on all flights varied between years and occasionally between flights in the same year.

No field data were obtained for 1968; and in 1969 only adult:fawn ratios were determined from a fixed-wing (Piper Supercub) survey of the area in mid-February by Dr. Robert Watts, Game Management Biologist, Region Four.

Table 1. Dates, area coverage, weather conditions, flying time, and mule deer observation data for aerial (helicopter) surveys on the Missouri Breaks Study Area, 1963-1975.

Year	Dates	Cover-age	Conditions	Total Hours	Total Deer	Deer/ Hour	Total Groups	No./ Group	Percent Each Group Class				
									1	2	3-5	6-10	11+
1963	12/18-19	Incompl.	Good	4.0	362	90.5	117	3.09	16.2	12.8	47.0	21.3	2.5
1964	12/28-29	Compl.	Excl.	14.3	611	42.7	178	3.43	17.9	24.1	43.8	12.3	1.6
1965	12/27-29	Compl.	Good	14.5	434	29.9	123	3.52	17.8	24.3	40.6	15.4	1.6
1966	12/18-20	Incompl.	Poor	11.0	289	27.5	79	3.65	15.1	13.9	54.4	15.1	1.2
1967	2/3/68	Incompl.	Fair	3.0	115	38.3	-	-	-	-	-	-	-
1968	-	-	-	-	-	-	-	-	-	-	-	-	-
1969	-	-	-	-	-	-	-	-	-	-	-	-	-
1970	12/28-30	Compl.	Good	14.5	776	53.5	172	4.51	17.4	20.3	44.1	15.6	2.3
1971	12/27-29	Compl.	Excel.	12.45	679	54.5	186	3.65	23.6	22.0	34.9	16.6	2.6
1972	3/6-7/73	Incompl.	Fair	7.5	235	31.3	-	-	-	-	-	-	-
1973	12/30-1/1	Compl.	Good	11.75	370	31.5	91	4.06	26.3	12.0	36.2	21.9	3.2
1974	1/19-22/75	Compl.	Fair	18.5	315	17.0	109	2.89	33.0	20.1	33.0	12.8	0.9
1975	12/8-12/75	Compl.	Fair	18.0	323	17.9	108	2.99	24.0	27.7	36.1	12.0	0.0

The proportion of the study area actually covered in the winter helicopter surveys varied considerably in some years, as did weather and snow cover at the time surveys were completed. Total hours flown each year generally reflected both of these factors as well as total numbers of deer observed. The exceptionally high efficiency of the first (1963) survey occurred as a result of only general coverage of the area under good conditions and high observability of deer at a time when numbers of deer on the area were relatively high. The increased hours flown in 1974 and 1975 as compared with earlier surveys reflected more intensive coverage of all parts of the study area under only fair conditions for observation and relatively low deer numbers. The effect of this was to increase the number of deer occurring as single animals or in pairs in the observations (Table 1).

Supplemental aerial surveys were made in mid-October 1975, employing a Piper Supercub and in late March 1976 using the same Bell helicopter and pilot as the early winter flight. Some general ground observations and classification counts were made in early spring and fall of other years as opportunity permitted.

Quantitative data on mule deer harvests on the study area were obtained only from 1960 through 1965. Hunter checking stations operated on main access roads during the first two or three weekends of the hunting season, voluntary hunter register boxes on all access routes and field checks of hunters and hunting camps throughout the season were employed in these efforts. Only general observations on hunter numbers, distribution and harvest, plus questionnaire estimates of the total mule deer harvest for Hunting District 410 were obtained from 1966 through 1975.

Population Trend Estimates

Minimal population estimates for the period 1960-1963 were obtained by plotting numbers of deer observed by location on gridded aerial photographs and the aerial surveys during early winter.

The annual helicopter surveys provided basic data upon which population estimates and trend for 1964-67 and 1970-75 could be derived when other factors (including the proportion of the study area actually flown, the pattern and intensity of coverage, the distribution of deer on the area, the observability of the deer as influenced by their activity and use of timber and brush cover in relation to weather and snow cover) were considered in light of knowledge of deer distribution and habitat usage from previous, intensive studies on the area during 1960-64. These estimates assumed that absolute total counts were not achieved; though under good to excellent conditions and complete coverage most (75-80 percent) of the deer probably were seen and counted. In most years, particularly earlier in the study, somewhat less than that level of efficiency (approximately 60-70 percent) apparently was achieved. Further, it was assumed that under similar conditions and coverage the number of deer observed per hour (Table 1) at least generally reflected the direction of trend in mule deer numbers on the area if not the magnitude of change between years.

Hesselton (1966) found that helicopter counts recorded less than 50 percent of the known white-tailed deer present under no snow conditions to 60-65 percent with snow on the Seneca Army Depot in N.Y., an area largely open and devoid of conifer cover.

After general population trend and a general density estimate were established, the structure of this population was calculated from observed sex and age ratios such that comparisons could be drawn between years. This permitted estimates to be refined as necessary to account for absolute numbers of each sex-age class present as well as any known or estimated mortality since the previous estimate. Thus the numbers in the total population, the adult population, males, females, yearling males, and fawns, all had to agree with those of the previous year and the following year. This approach served to increase the accuracy of the estimates substantially, at least in regard to the direction and degree of change between years.

No base survey data were available upon which to develop population estimates and trend for 1967, 1968, and 1969. However, a reasonable estimate for 1966 and another for 1970, when good survey conditions prevailed, provided a framework for calculation of population trend through these three years. Also, classifications indicative of relative proportions of adults and fawns in winter populations of 1967-68 and 1969-70 as well as adult females in 1967-68 were available. Using these data, plus average "turnover" rates for other years, it was possible to determine approximate population levels for each year and to calculate the composition of the 1968-69 population.

STUDY AREA

The study area encompassed all of the timbered "breaks" portion of the area described by Mackie (1970) as extending approximately 20 miles in a 4- to 7-mile wide belt adjacent to the Missouri River in Fergus County, Montana (Fig. 1). It comprised approximately 100 square miles between U. S. Highway 191 on the west, the Skyline Trail on the east, the Missouri River on the north, and the Musselshell Trail on the south. Physiography, climate as well as weather conditions during 1960-64, land use, and vegetation of this area were described in detail by Mackie (1970).

Weather Conditions 1960-1976

Growing season and annual precipitation data for the U. S. Department of Commerce Weather Service Station, Roy 8NE, located approximately 15 miles southwest of the center of the study area, are shown in Table 2. Monthly and total snowfall for the principal winter months (December-March) on the area are also listed. Mean annual precipitation for the 16-year (1960-1975) study period was 1.53 inches greater than the 25-year (1939-1963) mean of 13.43 inches reported by Mackie (1970). Snowfall records, recorded at Roy 8NE only since 1950, show a 27-year (1950-1976) mean of 30.1 inches total snowfall from December through March, winter periods. This included a mean 27.8 inches for the 10 years prior to 1960, and 31.4 inches from 1960 through 1976.

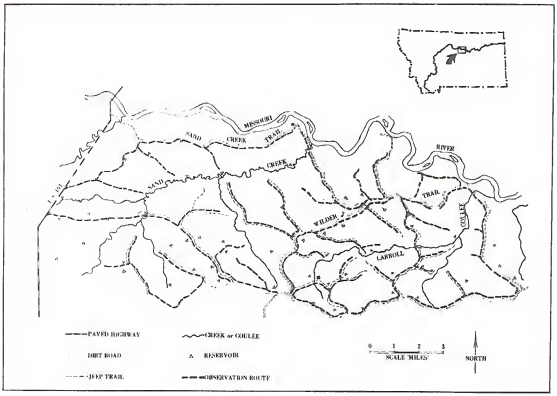

Figure 1. Map of the Study Area.

Table 2. Growing season and annual precipitation and monthly winter snowfall, 1960-1975, for Roy 8 NE, approximately 15 miles southwest of the center of the Missouri Breaks Study Area.

	Precipitation(in.)		Snowfall (in.)				
Year	April-June	Total	Dec.[1]	Jan.	Feb.	Mar.	Total
1960	4.90	8.89	T	23	9	5	37
1961	3.81	10.61	9	4	T	3	16
1962	12.91	23.14	2	11	4	3	20
1963	6.93	14.29	2	16	13	T	31
1964	9.45	18.21	11	3	T	10	24
1965	6.97	15.75	20	15	16	14	65
1966	5.85	12.52	2	14	10	7	33
1967	6.07	13.40	14	10	5	10	39
1968	8.49	14.30	8	4	6	4	22
1969	6.34	12.56	9	21	7	6	43
1970	9.54	16.54	4	7	11	10	32
1971	5.02	11.52	4	28	2	5	39
1972	4.42	13.98	21	21	5	13	60
1973	7.31	13.85	11	T	1	0	12
1974	5.96	17.32	6	4	2	7	19
1975	11.31	22.48	3	6	5	6	20
1976	-	-	9	4	4	6	23
Means	7.20	14.96	8	11	6	6	31

[1]December of previous year.

RESULTS

Population Trends

Population trends and estimated densities for mule deer on the study area during early winter each year from 1960-61 through 1975-76 are shown in Figure 2. Also illustrated are trends in proportions of adult males, adult females, and fawns as indicated by annual winter classifications across the area (Table 3). Proportions of fawns in the 1969-70 and 1972-73 early winter population estimates were based on classifications during mid-February and early March, respectively, and could be relatively low as some mortality may have occurred from December when classifications were made in most other years. Also, data in Figure 2 cannot be interpreted as estimates of size and trend in breeding (June) populations. In most years some fawn mortality as well as adult losses probably occurred later in the winter; in 1964-65 and 1971-72, especially, these losses appeared to have been particularly severe.

Year to year trends indicated a decline in mule deer numbers from 1960 to 1961, partial recovery from 1962 to 1963 followed by a sharp decline from early winter 1964-65 to the following December, consistent increases each year from 1967 to 1970, and another substantial decline from 1971 through 1975. The 1960-1961 decline resulted in approximately 20 percent fewer deer during the latter winter; while that of 1964-1965 reflected a change of about 30 percent between years. The most significant portion of the decrease from 1970 to 1975 occurred between December 1971 and the following winter when numbers dropped approximately 50 percent. Relatively slight declines occurred from 1970 to 1971 and from 1973 to 1974, while no noticeable year-to-year change was evident for 1972-1973 and 1974-1975. However, by 1975 total numbers on the area in early winter were about 64 percent less than those at the "peak" in 1970-71. The latter appeared to represent about the same density and total numbers as observed on the area at the beginning of the study in early winter 1960-61, and followed four years of consistent increase at an average rate of about 12 percent (5.8-21.4) per year.

Population trends throughout the 15-year period were closely associated with the proportions of fawns present at the time annual classifications and population estimates were made. The proportion of fawns in the population each year (Fig. 2) varied more and more directly with trend than the proportions of adult males and adult females. Although adult numbers generally followed the overall population trend, they usually lagged one year behind the total numbers and numbers of fawns. These relationships are clearly evident in the data presented in Table 4. Increasing populations were invariably associated with numbers of fawns exceeding 30-33 percent of the population; relatively stable populations with fawn percentages from about 27 to 30 percent; and decreasing populations with fawn percentages less than 25-27 percent. Generally, in increasing population situations, higher percentages of fawns were indicative of greater increases, and in decreasing situations, lower fawn percentages signified greater declines; but some variation occurred, probably because declines were not solely the result of low fawn production and/or survival to early winter in all cases.

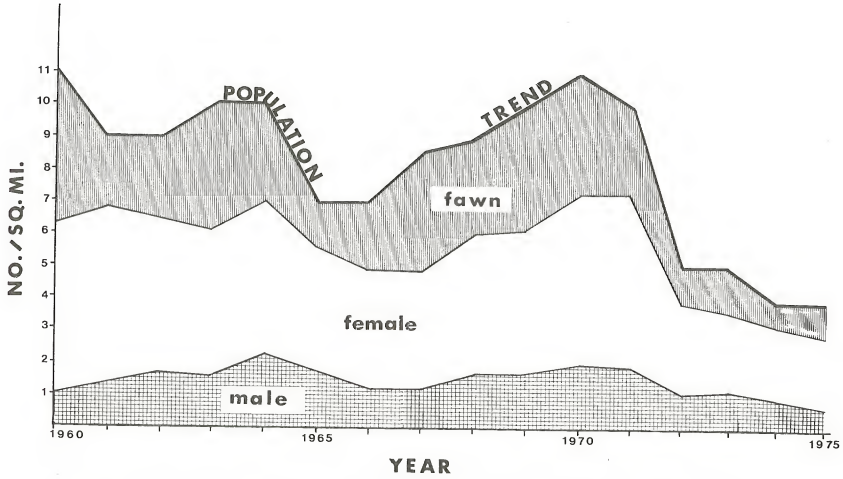

Figure 2. Population trend of mule deer on the Missouri Breaks Study Area, 1960-1975.

Table 3. Sex and age composition of mule deer population on the Missouri Breaks Study Area, 1960-61 through 1975-76. Data were derived as aerial or ground classifications during December or early January of each year except 1969-70 and 1972-73, when classifications were completed during February and March, respectively.

Year	Type of Observation	Number Classified	Percentage			Ratios			% of Yrlg Males	
			Males	Female	Fawns	Males: 100 FF	Fawns: 100 FF	Fawns: 100 AD	Obsv.	Harv.
1960-61	Ground[1]	668	9.3	48.6	42.1	19.1	86.4	72.6	56	46
1961-62	Ground	430	15.5	60.7	24.0	25.3	39.5	31.5	74	47
1962-63	Ground	190	19.5	52.1	28.4	37.5	54.5	39.7	63	34
1963-64	Aerial[2]	362	16.0	45.6	38.4	35.1	84.2	63.3	47	36
1964-65	Aerial	611	22.7	47.8	29.5	47.6	61.6	41.7	47	43
1965-66	Aerial	434	21.4	58.1	20.5	36.9	35.3	25.8	33	13
1966-67	Aerial	289	17.3	52.6	30.1	32.9	57.2	43.1	46	
1967-68	Aerial[3]	115	20.0	40.0	40.0	50.0	100.0	66.7	--	
1968-69	None	-	-	-	-	-	-	-	--	
1969-70	Aerial	110	-	-	39.1	-	-	64.2	--	
1970-71	Aerial	776	18.8	48.1	33.1	39.1	68.9	49.5	47	
1971-72	Aerial	679	19.0	53.8	27.2	26.1	50.6	37.4	46	
1972-73	Aerial	235	-	-	19.1	-	-	23.7	--	
1973-74	Aerial	370	24.1	49.5	26.5	48.6	53.6	36.0	43	
1974-75	Aerial	315	25.6	55.1	19.3	46.0	35.1	24.0	50	
1975-76	Aerial	323	15.5	57.6	26.9	26.9	46.8	36.9	28	
Mean Percentages and Ratios			18.8	51.5	29.6	36.2	59.5	47.7	40.0[4]	

[1] Cumulative observations on area during December.
[2] All aerial observations by helicopter except 1969-70 (fixed wing aircraft).
[3] Only west half of area surveyed in 1967-68.
[4] Mean derived of harvest ratios 1960-63 and aerial observations 1964-73.

Table 4. Calculated population size, composition, and turnover on the Missouri River Breaks Study Area, 1960-61 through 1975-76. Data are for early winter of each year.

Year	Total Number	Number				Percent Males	Percent Fawn
		Male	Female	Fawn	1-1/2 Male		
1960-61	1,100	102	535	463	47(46%)	9.3	42.1
		232	231				
		334	766				
	Turnover = -196(58.9%)		-220(28.7%) = -416 (37.8%)				
1961-62	900	138	546	216	65(47%)	15.5	24.0
		108	108		28% Surv.		
		246	656		from 1960		
	Turnover = - 71(28.8%)		-185(28.3%) = - 256 (28.4%)				
1962-63	900	175	469	256	60(34%)	19.5	28.4
		128	128		55.6% Surv.		
		303	597		from 1961		
	Turnover = -143(47.2%)		-141(23.6%) = - 284 (31.5%)				
1963-64	1,000	160	456	384	75(47%)	16.0	38.4
		192	192		58.5% Surv.		
		352	648		from 1962		
	Turnover = -125(35.5%)		-170(26.2%) = -295 (29.5%)				
1964-65	1,000	227	478	295	107(47%)	22.7	29.5
		148	147		55.5% Surv.		
		375	625		from 1963		
	Turnover = -225(60.0%)		-218(34.8%) = -443 (44.3%)				
1965-66	700	150	407	143	50(33%)	21.4	20.5
		72	71		33.8% Surv.		
		222	478		from 1964		
	Turnover = -101(45.5%)		-110(23.0%) = -211(30.1%)				
1966-67	700	121	368	211	56(46%)	17.3	30.1
		106	105		78% Surv.		
		227	473		from 1965		
	Turnover = -107(47.1%)		-108(22.8%) = -215 (30.7%)				
1967-68	850*	120	365	365	56(47%)	20.0	40.0
		193	182		52.8% Surv.		
		303	547		from 1966		
	Turnover = -137(45.2%)		-113(20.7%) = -250 (29.4%)				
1968-69	900*	166	434	300		18.4	33.3
		150	150				
		316	584				
	Turnover = -148(46.8%)		-133(22.8%) = -281 (31.2%)				
1969-70	1,000*	168	451	391		16.8	39.1
		196	195				
		364	646				
	Turnover = -166(45.6%)		-118(18.3%) = -284 (28.4%)				

Table 4. Continued.

Year	Total Number	Number				Percent Males	Percent Fawn
		Male	Female	Fawn	1-1/2 Male		
1970-71	1,100	198	528	363	93(47%)	18.8	33.1
		182	181		47.4% Surv.		
		380	709		from 1969		
	Turnover = -190(50%)		-171(24.1%) = -361 (32.8%)				
1971-72	1,000	190	538	272	87(46%)	19.0	27.2
		136	136		41.2% Surv.		
		326	674		from 1970		
	Turnover = -208(63.8%)		-388(57.6%)** = -596 (59.6%)				
1972-73	500	118	286	96		24.0	19.1
		48	48				
	Turnover = - 46(27.7%)		- 86(25.7%) + -132 (26.4%)				
1973-74	500	120	248	132	48(40%)	24.1	26.5
		66	66		100% Surv.		
		186	314		from 1972		
	Turnover = - 83(44.6%)		- 94(29.9%) = -177 (35.4%)				
1974-75	400	103	220	77	51(50%)	25.6	19.3
		39	38		87.9% Surv.		
		142	258		from 1973		
	Turnover = - 80(56.3%)		- 28(10.9%) = -108 (27%)				
1975-76	400	62	230	108	17(28%)	15.5	26.9
					43.6% Surv.		

*Calculated based on mean turnover of 47 percent males, 23 percent females, plus observed age ratios, except 1968-69.

**Overwinter losses calculated from change in age ratio January to April as 83 percent fawns and 31 percent adults.

Noticeable declines in numbers of adults as well as the number and proportion of fawns occurred directly in association with large declines in total numbers of deer in 1964-65 and 1971-72. Both years were characterized by unusually heavy snowfall (Table 2) which began in early December and persisted into March. On the other hand, numbers of adults, both males and females, increased from 1960-61 to 1961-62 despite an approximate 20 percent total population decline. This indicated the conditions which influenced the 1960-1961 decline did not affect adult mortality greatly, and/or that large numbers of yearlings from the excellent 1960 fawn crop (Table 3) were recruited into the population in 1961 despite the fact that the proportion of fawns which survived was relatively low (Table 4) that year. Slight declines in adults, expecially females, in 1962-63 and 1963-64 populations would indicate that the 1961 and 1962 cohorts were not adequate in number or did not survive in sufficient proportion to compensate for adult mortality. Similarly, continued declines in adult numbers in 1966-67, 1973-74, 1974-75, and 1975-76 from preceding years would indicate either inadequate numbers or survival to yearling age of fawn cohorts born in 1965 and 1972, 1973, and 1974, respectively.

Population Turnover

Table 4 shows numbers of adult males, adult females, fawns, and yearling males comprising estimated populations from 1960-61 through 1975-76, together with percentage loss (turnover) for males, females, and the total population as well as male fawns from one year to the next. Calculations were similar to those employed by Cronemiller (1951) in computing the dynamics of the Interstate (Oregon-California) deer herd. For example, the 1960 population of 1,100 (11/mi^2 over the 1,100 sq. mi. study area) should have included approximately 334 males (102 yearling and older adults plus 232 male fawns) and 766 females (535 yearling and older adults and 231 fawns). In the 1961-62 winter, the 900 estimated deer included 138 adult males (a decrease of 196 or 58.9% from the 334 total males present the previous winter) and 546 adult females (a decrease or turnover of 220 or 37.8% from the 1960-61 population). Of the 1,100 total mule deer on the area in December 1960, apparently only 648 remained in December 1961--a turnover of 416 or 37.8 percent. Also, approximately 65 (47%) of the adult males present in December 1961 were yearlings; a difference of 72 percent from the estimated 232 male fawns recorded in December 1960.

On the basis of these calculations, annual turnover in males was indicated to range from a low of about 28 percent (1961 to 1962 and 1972 to 1973) to highs of about 60 percent (1960 to 1961, 1964 to 1965, and 1971 to 1973). The 15-year average for males was 46.9 percent. Similarly, for females annual turnover varied from a low of 10.9 percent (1974 to 1975) to a high of 57.6 percent (1971 to 1972). The mean rate for females was 26.5 percent per year. Although the total population turnover ranged between 27 percent and 60 percent (mean 33.5%), it exceeded 37-38 percent only in years of extraordinary mortality (1964-1965 and 1971-1972) and typically averaged only about 30 percent. Survival of male fawns to

yearling age varied widely between lows of about 28 percent in 1960-61 to 1961-62 and 1974-75 to 1975-76 and the highs of 100 percent and 88 percent between 1972 and 1974. The average for 12 years in which data were obtained was 57 percent.

The calculations assumed that the sex ratio of fawns observed on the area in early winter was approximately equal each year. This may not always have been the case. Male:female ratios (Table 3) generally increased for one or two years following sharp population declines. A phenomenon which might indicate that proportionately more male fawns were born or recruited into the adult population and/or that mortality of adult and/or yearling males was reduced relative to that of females. There was some evidence that both may have occurred. Higher than average survival of male fawns was indicated for 1965 to 1966, from 1972 to 1973 and from 1973 to 1974; while much lower than average turnover among males was suggested for 1961-1962 and 1972-1973. Also, as many yearling males apparently occurred on the area in 1973 as comprised one-half of all fawns in early winter 1972-73, and nearly as many (88%) in 1974. Either more of the fawns observed in early winter were male than female or some immigration of yearling males had to occur. (Verme (1969) reported that males predominated among fawns of white-tailed does subjected to nutritional deficiencies, as would have occurred on the study area in years of high mortality and population decline. On the other hand, recent radio-tracking studies on the Nichol's Coulee RCA (Knowles 1975, 1976), northeast of the study area, have suggested that yearlings of both sexes may move extensively within the breaks as well as between the breaks and adjacent prairies, at least in some years.

The average turnover rate among males (47%) was essentially the same as the percentage of yearlings among adult males on the study area in early winter each year (Tables 3 and 4). Yearling percentages of less than 46-50 percent occurred only in years immediately following very low fawn production or survival to early winter, or extraordinary late winter mortality, or in association with lower-than-average total male turnover. Except in the latter case (1962-63 and 1972-73), they were also associated with significant decreases in numbers of bucks in the population.

In view of the close relationship between male turnover and yearling male percentages, it would seem to follow that a similar relationship might exist among females; wherein approximately 25 percent of adult females would be yearlings. Age compositions of deer harvests (Table 5) did not indicate this to be the case, at least for 1960-1962. Since the female segment could not be sustained without yearling increments equal to losses, either the harvest data were not representative or fawn-yearling turnover is proportionately higher or that of adults older than fawns proportionately lower than for males. In general, the female population declined, often substantially, at average or greater annual turnover rates and remained stable or increased only when the rate held at 24 percent or less.

Table 5. Distribution of mule deer harvest by sex and age classes. Missouri Breaks Study Area, check station data, 1960-1965.

Year	Total Checked	Percentage of Total	Percentage of Adults	½	1½	2½	Mature (3½-6½)	Old (7½+)
Male:								
1960	88	49	51	14(12)[1]	46(39)	15(13)	18(15)	7(6)
1961	83	50	50	17(14)	47(39)	13(9)	18(13)	6(5)
1962	47	47	47	18(8)	34(13)	39(15)	8(3)	0
1963	22	63	62	27(6)	36(8)	14(3)	23(5)	0
1964	48	64	66	7(3)	43(20)	15(7)	28(13)	7(3)
1965	16	60	67	13(2)	13(2)	20(3)	33(5)	20(3)
Female:								
1960	93	51	49	29(19)	15(10)	((6)	20(13)	26(17)
1961	80	50	50	12(10)	19(13)	&(5)	47(34)	15(11)
1962	52	53	53	19(7)	10(4)	27(11)	30(13)	18(7)
1963	13	37	37	23(3)	8(1)	15(2)	31(4)	23(3)
1964	27	36	34	17(4)	26(6)	17(4)	30(7)	9(2)
1965	12	40	33	18(2)	27(3)	9(1)	36(4)	9(1)

[1]Number checked in parenthesis.

DISCUSSION

Factors Affecting Population Trend and Dynamics

The preceding findings indicated that fawn production and/or survival to early winter and/or, ultimately, to recruitment into the adult population was a basic factor influencing population trend. Periodic, "catastrophic" mortality associated with severe environmental conditions, which influenced substantial additional mortality of fawns plus some extraordinary mortality of adults, was also important in that it led directly to two substantial and one slight to moderate population declines during the 15 years. However, both of these factors or forces operated within or in relation to pre-existing annual turnover rates which appeared to be characteristic of the population as a whole and for the two sexes, individually, over time. The following discussions evaluate some factors affecting turnover rates and fawn production or survival on the study area as related to population trends and dynamics of the deer population from analyses to date.

Turnover Rate

The population data indicated that approximately 30-33 percent of all mule deer present on the study area in early winter of any one year would be lost by the following year. This included about 25-27 percent of all females and 46-47 percent of all males. These rates generally held in increasing as well as decreasing population trends and during periods of light hunting pressure and harvest as well as extremely heavy pressure and harvest; though some significant variation occurred.

Above average turnover between years was associated in nearly all cases with downward population trends, particularly those associated with periodic severe environmental conditions resulting in extraordinary mortality. Lowest rates generally occurred in years immediately following the highest, possibly indicating some compensatory effect; however, it also seems likely that that unusually high mortality in one year would have removed animals which otherwise would have been subject to loss at the "normal" rate during following years.

The calculated turnover among females from 1971 to 1972 was disproportionately higher than average for females as compared with males, indicating that adult mortality associated with the severe population decline during that period was slanted toward females. This difference was less pronounced in turnover of the two sexes during the decline of 1964-1965; though again adult mortality appeared to include a slightly higher proportion of females. This difference might have been expected in view of the nature of the mortality (severe winter) in both cases, the extreme difference in turnover rates for the two sexes, and hunting pressures and harvests influencing age distributions of mule deer on the study area from 1960 through 1971.

Winter mortality characteristically is disproportionate to very young (fawns) and very old animals. Males, with much higher normal turnover, would be expected to show a much younger overall age distribution on the study area, with relatively few "old" aged animals, as compared with females. Indeed, this was the case through the early 1960's (Table 5). With proportionately more females living to old and very old ages, relatively large numbers would be subject to catastrophic winter mortality. The fact that hunting pressures and harvest were extremely heavy on the study area during the 1960-1962-63 period (Table 6) and almost evenly divided toward males and females (Table 5), at least through 1962, resulting in a relatively young female as well as male age distribution, probably accounts for the relatively slight difference in added-turnover of adult males and females in 1964-1965 as compared with 1971-1972. Low harvest, increasingly heavily weighted to bucks, (Table 5) favorable conditions for population growth and survival with relatively low annual turnover, would very likely have favored movement of substantial numbers of females into vulnerable (to winter mortality) old and very old age classes by the winter of 1971. At the same time males, being subject to both higher normal turnover and consistent, moderate to heavy hunting pressure, especially after 1967 or 1968, likely continued to number relatively few individuals in vulnerable age classes.

Since the study population was subject to moderate to heavy hunting of both sexes during all but the last year of the study (1975), there may be reason to question the possible role or importance of hunting in annual turnover. Obviously, the harvest comprised a substantial, though variable part of the turnover measured in all years. Further, there was some indication from the sharp decline in the female turnover rate from 1974 to 1975 in the absence of either sex hunting in 1975, that this factor could be significant. The 10.9 percent female turnover recorded in 1974-1975 was less than one-half the "normal" or average rate recorded for females over the 15 years. However, it is also possible that the reduced rate for females in 1974-1975 is only a temporary artifact of the present age structure of the female segment of the population. Under a generally declining population trend during the past several years with exceptionally low fawn survival plus direct mortality of at least 30 percent of the adults present in early winter 1971 (including an even greater proportion of the females), the present female population may have been comprised largely of prime-aged animals. These might have been expected to have some survival advantage in the absence of hunting. However, we might expect that within a year or two as greater numbers of young enter the population as they will have to if even a very minimum population is to be maintained, and the now prime adults become older and subject to higher natural mortality, that the female turnover rate might return to a more normal 20-25 percent even without hunting. In this respect, it may be significant that female turnover ranged from about 18 percent to 24 percent from 1965 to 1971, a period when conditions were favorable to reproduction and survival of mule deer and hunting pressures were very light to moderate (Table 6, Appendix Table 2). "Average" male turnover rates also appeared to persist throughout the period despite relatively very low harvests in the mid-1960's increasing to possibly heavy harvest by 1969-71.

Table 6. Mule deer harvests on and adjacent to the Missouri River Breaks Study Area, 1958-1973.

Year	Season Type-Length	$20/35NR[1] Permits	No. Harvested/Sq.Mi. HD 410[2]	Res. Area[3]
1958	1 Deer, ES, 35 days	Unlimited	1.1	1.0+
1959	2 Deer, ES, 53 days[4]	Unlimited	1.3	1.5 - 2.0
1960	2 Deer, ES, 50 days[4]	Unlimited	1.5	3.0 - 3.5
1961	2 Deer, ES, 35 days[5]	Unlimited	1.5	3.5 - 4.0
1962	2 Deer, ES, 50 days[4]	Unlimited	1.6	2.0 - 2.5
1963	2 Deer, ES, 36 days	None	1.9	1.0 - 1.5
1964	2 Deer, ES, 36 days	500	1.9	1.0+
1965	2 Deer, ES, 36 days	400 MD	0.8	less than 1
1966	2 Deer, ES, 36 days	500	1.1	less than 1
1967	2 Deer, ES, 36 days	500	0.8	less than 1
1968	2 Deer, ES, 36 days	500	1.0	1.0+
1969	2 Deer, ES, 36 days	500	1.0	1.0+
1970	2 Deer, ES, 43 days	500	1.0	1.0+
1971	2 Deer, ES, 43 days	500	1.4	1.0+
1972	2 Deer, ES, 36 days	500	1.0	less than 1
1973	"A" W-T, "B" MD, 36 days	None	---	less than 1
1974	"A" ES "B" WTD, 36 days	None	---	less than 1
1975	"A" MD Buck Only, 36 days WTD, ES "B" WTD, ES	None	---	less than 1

[1]N-R Permits $35.00 after 1966.
[2]Approximately 3,100 sq. mi. surrounding study area to south. Annual Mule Deer harvests averaged approximately 4,550 (2,603-6,800) from 1958 through 1972.
[3]Harvest estimates based on weekend checking stations, random field checks, voluntary check station returns from 1959-1965.
[4]Includes special 2 week early season in Breaks area.
[5]Additional 1 week, 100 antlerless permit season in December.

Reproduction and Survival of Fawns

Fawn production and/or survival to early winter varied greatly between years (Table 3, Fig. 3). Observed ratios ranged from lows of about 35 fawns:100 females and 24-25 fawns:100 adults to highs of 100 fawns:100 females (67 fawns:100 adults) and 86 fawns:100 females (73:100 adults). Averages for the 16-year period spanned by the data were approximately 60 fawns:100 females and 48 fawns:100 adults.

As indicated by population trends, fawn percentages exceeding 30-30 percent of the early winter population were generally associated with increasing mule deer populations; percentages less than 25-27 percent with declines. Stability was indicated by percentages of 27-30 percent. The latter reflected observed ratios of approximately 55-60 fawns:100 females (depending upon the proportion of adult males in the population) or about 40 fawns:100 adults; which apparently represent the approximate minimum reproductive effort and/or survival required to maintain the mule deer population with respect to "normal" annual losses or turnover. Fawn:doe ratios of 70-100 fawns:100 females (50-70:100 adults) were associated with population increases ranging from 5 to 20 percent per year, approximately in proportion to the ratio. Ratios below about 40 fawns:100 females and 30 fawns:100 adults were associated with significant population declines.

Although a detailed analysis of factors influencing fawn production and/or survival is not attempted at this time, very low ratios in some years could be associated with relatively severe environmental conditions influencing substantial population declines. The low 40 fawns:100 females (31:100 adults) in 1961 was associated with unusually severe drought conditions on the area during 1960-1961. Subsequent "lows" in 1965 and 1972 followed exceptionally severe winters. Ratios indicating moderate to good fawn production or survival to early winter in 1964 (62 fawns: 100 females) and 1971 (69 fawns:100 females) were recorded prior to extensive fawn mortality later in the winter, exceeding 50-60 percent in 1964-65 and 85-90 percent in 1971-72. Further fawn mortality after early winter classifications were made also appeared to have occurred during 1973-74, 1974-75, and 1975-76.

Severe environmental conditions apparently were not important in the relatively low fawn production or survival from 1973 through 1975 or with additional late winter mortality. All years from 1972 on were marked by above normal precipitation during growing seasons, and generally favorable range-forage conditions on the area, and by relatively mild, open winters with considerably less than normal snowfalls. Apparently, some other factor was involved. Knowles (1976), evaluated trends in fawn production and survival on the study area and adjacent breaks of the Nichol's Coulee RCA from summer through spring 1975-76 and concluded that coyote predation could have been a major factor in low ratios after 1973. The relatively low-moderate ratio for early winter 1973-74 was very similar to ratios observed following very low fawn production and survival associated with severe environmental conditions in 1962 and 1966; thus it is possible that some lag effects on reproduction of mule deer extend through a second year after severe conditions.

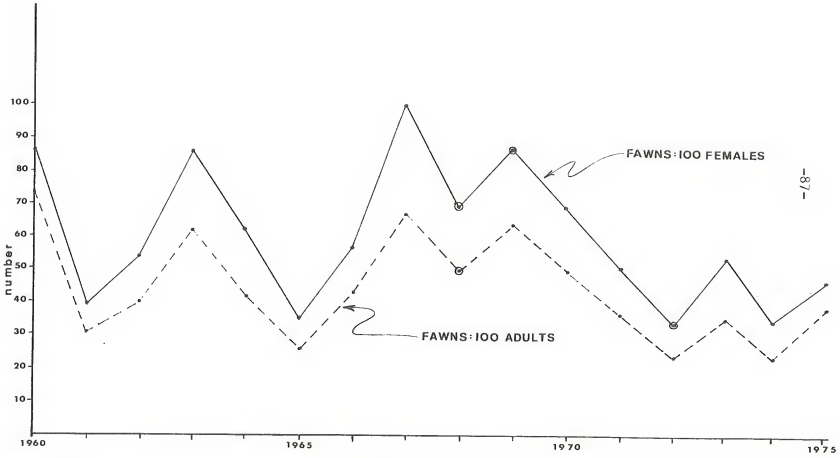

Figure 3. Trends in fawn:doe and fawn:adult ratios for mule deer on the Missouri Breaks study area, 1960–1975. Ratios are for early winter populations, except 1967 and 1969 (February) and 1972 (March). Points circled are estimated ratios calculated on the basis of population trends.

Annual variations and trends in fawn production and survival as indicated by ratios did not appear closely correlated with population size or density, with general trends in utilization and conditions of preferred forage plants, nor with general trends in growing season or annual precipitation or total winter snowfall, except in cases of extreme deviations as the drought of 1960-61 and unusually heavy snow accumulation in early December persist into late winter as in 1964-65 and 1971-72. More detailed, statistical evaluations of these relationships will be presented in a subsequent report.

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Submitted by: R. J. Mackie

APPENDIX TABLE 1.

DISTRIBUTION OF MULE DEER OBSERVATIONS AND CLASSIFICATIONS BY SECTION OF THE MISSOURI RIVER BREAKS RESEARCH STUDY AREA - HELICOPTER SURVEY - LATE DECEMBER/JANUARY 1963-1966 AND 1970-1975, EXCEPT 1972*

Year	Total	Males	Females	Fawns	Males 100 Females	Fawns 100 Females	Fawns 100 Adults
Northwest Sand Creek:							
(1) South King Coulee							
1963	15	0	8	7	-	87.5	87.5
1964	7	0	5	2	-	40.0	40.0
1965	10	0	9	1	-	11.1	11.1
1966	30	4	17	9	23.5	52.9	42.8
1970	29	4	14	11	28.6	78.5	61.1
1971	20	3	12	5	25.0	41.6	33.3
*1972	0	(did not cover completely)			-	-	-
1973	4	2	1	1	200.0	100.0	33.3
1974	0	0	0	0	-	-	-
1975	12	2	7	3	28.6	42.9	33.3
(2) North King Coulee - South Sand Creek Trail							
1963	31	9	14	8	64.3	57.1	34.8
1964	72	16	33	23	48.5	68.7	46.9
1965	54	15	32	7	46.9	21.8	14.8
1966	15	5	8	2	62.5	25.0	15.3
1970	46	11	22	13	50.0	59.0	39.4
1971	84	25	47	12	53.1	25.5	16.6
1972	50	(42 adults)		8	-	-	-
1973	37	10	20	7	50.0	35.0	23.3
1974	9	3	3	3	100.0	100.0	50.0
1975	29	3	20	6	15.0	20.0	26.1
(3) North King Coulee - North Sand Creek Trail							
1963	0	(Did not cover area)			-	-	-
1964	81	22	38	21	57.8	55.2	35.0
1965	43	16	21	6	76.1	28.5	16.2
1966	8	3	3	2	100.0	66.7	33.3
1970	72	22	30	20	73.3	66.7	38.5
1971	47	18	20	9	90.0	45.0	23.7
1972	22	(18 adults)		4	-	-	22.2
1973	29	11	13	5	84.6	38.5	20.8
1974	67	17	33	17	51.5	51.5	34.0
1975	47	14	21	12	40.0	43.8	31.3
COMBINED TOTAL:							
1963	46	9	22	15	40.9	75.0	48.3
1964	160	38	76	46	50.0	60.5	40.3
1965	107	31	62	14	50.0	22.6	15.0
1966	53	11	28	14	20.8	52.8	43.8
1970	147	37	66	44	56.1	66.7	42.7
1971	151	46	89	26	51.6	29.2	20.8
1972	72	(60 adults)		12	-	-	20.0
1973	70	23	34	13	67.6	38.2	22.8
1974	76	20	36	20	55.6	55.6	35.7
1975	88	19	48	21	40.0	43.8	31.3

APPENDIX TABLE 1. CONTINUED.

Year	Total	Males	Females	Fawns	Males 100 Females	Fawns 100 Females	Fawns 100 Adults
Southeast Sand Creek:							
1963	95	16	42	37	38.0	88.0	63.7
1964	100	20	45	35	44.4	77.7	53.8
1965	58	6	42	10	14.2	23.8	20.8
1966	48	15	23	10	65.2	43.4	35.7
1970	152	29	82	41	35.4	50.0	36.9
1971	83	17	42	24	40.5	57.1	40.7
1972	46	(37 adults)		9	-	-	24.3
1973	46	11	22	13	50.0	59.1	39.4
1974	31	11	15	5	73.3	33.3	19.2
1975	57	7	37	13	18.9	35.1	29.5
Northeast Sand Creek							
(1) Southwest of Sand Creek Trail							
1963	48	6	21	21	28.6	100.0	77.8
1964	66	18	25	33	72.0	92.0	53.5
1965	82	19	41	22	46.3	53.6	36.6
1966	78	4	47	27	8.5	57.4	52.9
1970	152	22	70	60	31.4	85.7	65.2
1971	156	25	92	39	27.2	42.4	33.3
1972	32	(25 adults)		7	-	-	28.0
1973	48	13	24	11	54.2	45.8	29.7
1974	63	16	34	13	47.1	38.2	26.0
1975	56	9	27	20	33.3	74.1	55.6
(2) East of Sand Creek Trail and North of Wilder							
1963	18	1	11	6	9.1	54.5	50.0
1964	129	21	71	37	29.6	52.1	40.2
1965	58	5	32	21	15.6	65.6	56.7
1966	17	1	11	5	9.0	45.4	41.6
1970	22	7	9	6	77.8	66.6	37.5
1971	56	10	26	20	38.5	76.9	55.5
1972	0	(Did not cover this area)			-	-	-
1973	51	10	28	13	37.7	46.4	34.8
1974	25	7	11	7	63.6	63.6	38.9
1975	19	3	9	7	33.3	77.8	58.3
COMBINED TOTAL: Northeast Sand Creek							
1963	66	7	32	27	21.8	84.3	25.9
1964	195	39	96	60	40.6	62.5	44.4
1965	140	24	73	43	32.8	58.9	44.3
1966	95	5	58	32	8.6	55.1	50.7
1970	174	29	79	66	36.7	83.5	61.1
1971	212	35	118	59	29.7	50.0	38.6
1972	32	(25 adults)		7	(only 1/2 area covered)		28.0
1973	99	23	52	24	44.2	46.2	28.2
1974	88	23	45	20	51.1	44.4	29.4
1975	75	12	36	27	33.3	75.0	56.2

APPENDIX TABLE 1. CONTINUED.

Year	Total	Males	Females	Fawns	Males 100 Females	Fawns 100 Females	Fawns 100 Adults
(2) Dobb's Area							
1963	46	7	25	14	28.0	56.0	43.7
1964	76	28	32	16	87.5	50.0	26.6
1965	42	7	28	7	25.0	25.0	20.0
1966	39	6	20	13	30.0	65.0	50.0
1970	145	30	67	48	44.8	71.6	49.5
1971	121	19	64	38	29.7	59.4	45.8
1972	39	(34 adults)		5	-	-	-
1973	58	20	26	12	76.9	46.2	26.0
1974	54	16	30	8	53.3	26.7	17.4
1975	45	3	29	13	10.3	44.8	40.6
COMBINED TOTAL:							
1963	104	20	47	37	42.6	78.7	55.2
1964	102	33	46	23	71.7	50.0	29.1
1965	76	10	50	16	20.0	32.0	26.7
1966	59	10	29	20	34.5	69.0	51.3
1970	237	41	114	82	35.9	71.9	52.9
1971	164	20	90	54	22.2	60.0	49.1
1972	85	(68 adults)		17	-	-	-
1973	108	27	48	33	56.3	68.8	44.0
1974	78	23	43	12	53.5	27.9	18.2
1975	63	4	40	19	10.0	47.5	43.2
ENTIRE AREA TOTALS:							
1963	360	58	166	136	34.9	81.9	60.7
1964	611	144	288	179	50.0	62.1	41.4
1965	434	93	252	89	36.9	35.3	25.8
1966	289	50	152	87	32.9	57.2	43.1
1970	776	146	373	257	39.1	68.9	49.5
1971	679	129	365	185	26.1	50.6	37.4
1972	235	(190 adults)		45	-	-	23.7
1973	370	89	183	98	48.6	53.6	36.0
1974	315	80	174	61	46.0	35.1	24.0
1975	323	50	186	87	26.9	46.8	36.9

DISTRIBUTION OF MALES BY ANTLER CLASSES:

Year	Number Classified	Percentage				Percentage Yearling
		Spike	2-Point	3-Point	4-Point	
1963	58	7	36	16	41	43
1964	140	17	29	26	27	47
1965	93	9	24	25	42	33
1966	51	14	32	16	38	46
1970	146	28	19	28	25	47
1971	129	18	41	18	52	45
1972	0	-	-	-	-	-
1973	89	13	30	24	33	43
1974	78	7	32	16	23	50
1975	50	5	9	16	20	28

APPENDIX TABLE 1. CONTINUED.

Year	Total	Males	Females	Fawns	Males 100 Females	Fawns 100 Females	Fawns 100 Adults
Northwest Carroll Coulee:							
(1) East of Carroll Coulee Trail							
1963	25	5	14	6	35.7	43.8	31.5
1964	41	10	20	11	50.0	55.0	36.6
1965	33	11	18	4	61.1	22.2	13.7
1966	12	1	6	5	16.6	83.3	71.4
1970	27	4	14	9	26.6	64.3	50.0
1971	28	4	13	11	30.8	84.6	64.7
1972	0	(did not cover this area)			-	-	-
1973	20	5	10	5	50.0	50.0	33.3
1974	21	2	16	3	12.5	18.8	16.7
1975	22	5	13	4	38.5	30.8	22.2
(2) West of Carroll Coulee Trail							
1963	24	1	9	14	11.1	155.6	140.0
1964	13	4	5	4	80.0	80.0	44.4
1965	20	11	7	2	157.1	28.5	11.1
1966	22	8	8	6	100.0	75.0	37.5
1970	39	6	18	15	33.3	83.3	62.5
1971	41	7	23	11	30.4	47.8	36.7
1972	0	(did not cover this area)			-	-	-
1973	27	0	17	10	0	58.8	58.8
1974	21	1	19	1	5.3	5.3	5
1975	18	3	12	3	25.0	25.0	20.0
COMBINED TOTAL:							
1963	49	6	23	20	26.1	87.0	69.0
1964	54	14	25	15	56.0	60.0	38.4
1965	53	22	25	6	88.0	24.0	13.6
1966	34	9	11	64.3	64.3	78.6	47.8
1970	66	10	32	24	31.2	75.0	57.1
1971	69	11	36	22	30.5	61.1	46.8
1972	0	(did not cover this area)			-	-	-
1973	47	5	27	15	18.5	55.6	46.9
1974	42	3	35	4	8.6	11.4	10.5
1975	40	8	25	7	32.0	28.0	21.2
Southeast Carroll Coulee:							
(1) Colburn Area							
1963	58	13	22	23	59.1	104.5	65.7
1964	26	5	14	7	35.7	50.0	36.8
1965	34	3	22	9	13.6	40.9	36.0
1966	20	4	9	7	44.4	77.7	53.8
1970	92	11	47	34	23.4	72.3	58.6
1971	43	1	26	16	3.8	61.5	59.2
1972	46	(34 adults)		12	-	-	35.3
1973	50	7	22	21	31.8	95.5	72.4
1974	24	7	13	4	53.8	30.8	20.0
1975	18	1	11	6	9.1	54.5	50.0

APPENDIX TABLE 1. CONTINUED

*1972 flight made on March 6-7, 1973, after antler drop; area not completely covered in absence of any snow cover. (R. Watt w/Roger's Helicopter). Complete list of flight dates as follows:

1963: December 18-19, 1963
1964: December 28-29, 1964
1965: December 27-29, 1965
1966: December 18-20, 1966
1967: Partial coverage, west one-half of area (Sand Creek) only - February 3, 1968.
1968: No survey
1969: No survey
1970: December 28-30, 1970
1971: December 27-29, 1971
1972: Partial coverage as indicated, March 6-7, 1973
1973: December 30-31, 1973; January 1, 1974
1974: January 19-22, 1975
1975: December 8-12, 1975

Appendix Table 2. Total numbers of Mule Deer harvested from the Missouri River Breaks and adjacent prairies.[1]

Year	Hunting District 410[2]	62[2]	63[2]	68	72	Total
1959	5,117	1,442	826	2,642	2,687	12,714
1960	5,769	2,345	1,222	1,976	1,948	13,260
1961	5,951	996	904	383	2,580	10,814
1962	5,964	1,477	918	674	2,671	11,704
1963	6,683	897	990	914	3,460	12,854
1964	6,800	910	813	883	3,180	12,586
1965	2,945	510	955	448	2,154	7,012
1966	4,086	700	610	768	1,069	7,233
1967	2,603	542	419	268	1,893	5,725
1968	3,061	467	817	340	1,617	6,302
1969	3,102	648	584	1,049	2,754	8,137
1970	3,271	713	431	1,225	2,223	7,863
1971	4,245	220	612	545	2,527	8,149
1972	3,050	705	643	553	2,916	7,867
1973	1,689	593	558	517	4,384	7,741
1974	1,531	558	691	401	3,993	7,204
1975	890	588	413	299	1,743	3,933

[1]Point estimates for mule deer from annual hunter questionnaire.
[2]Hunting district split in 1973. Data are for pre-1973 hunting district. HD 410 = present HD 410 + HD 417; HD 62 = HD 620 + HD 621; HD 63 = HD 630 + HD 631, HD 68 = HD 680, HD 70 = HD 700 after 1973.

Job Title: Mule deer population ecology, habitat relationships, and relations to livestock grazing management and elk in the Missouri River Breaks, Montana - Nichol's Coulee RCA.

ABSTRACT:

Mule deer, elk and cattle range relationships were examined in a rest-rotation grazing system (Nichols Coulee RCA) in the Missouri River Breaks Northcentral Montana from 1973 through 1975-76. Mule deer numbers, classification and distribution were analyzed in relation to rest-rotation grazing. A 13 percent increase in numbers of deer counted from 1973-74 to 1975-76 was noted for the two pastures (III and IV) within the timbered breaks. Maximum numbers within these two pastures occurred during the year each pasture received the rest treatment. This was a result of increased numbers of adults and young in pasture III in 1974-75 and adults in pasture IV 1975-76. Fawn:doe ratios in pasture III were 61.0 and 31.5 during the years it received this rest and heavy use treatment, respectively. Possible residual effects of heavy grazing in pasture IV for two year's previous were observed in mule deer food habits and productivity in 1974. The decline in the fawn:doe ratio observed in association with the rest treatment of pasture IV in 1975 may have been partly due to a masking effect as a result of immigration of yearlings into the pasture. Three aerial surveys in 1975-1976 (early fall, early winter, and early spring) showed that fawns were being lost throughout the survey period. The fawn:doe ratio declined 51.2 percent from fall to winter and the young:adult ratio declined 73.7 percent from winter to spring. Predation by coyotes was believed to be associated with this observed decline in fawns. Deer numbers and production for the two pastures in the prairies (I and II) were inconsistent with grazing treatments and were lower and greater than observed for pastures III and IV, respectively. It was concluded other factors besides rest-rotation grazing were responsible for the low to moderate fawn:doe ratio observed for pastures III and IV during all three years. The effects of rest-rotation grazing during this study appeared to affect mule deer numbers and net production only to a minor degree.

Job Title: Mule deer population ecology, habitat relationships, and relations to livestock grazing management and elk in the Missouri River Breaks, Montana - Nichol's Coulee RCA.

Job Objective: To further determine the environmental requirements of mule deer and factors regulating mule deer populations in the "breaks" type of eastern Montana.

To further determine the direct and indirect effects of livestock grazing management under rest-rotational and continuous grazing systems upon deer populations and habitat relationships and upon deer-elk interrelationship in the "breaks" type.

To develop new and improved guidelines for management of mule deer populations and their habitats in the "breaks" type of eastern Montana and for consideration of deer habitat requirements in elk, livestock, and range management programs in this type.

INTRODUCTION

A rest-rotation grazing system for cattle *(Bos taurus)* was initiated in 1965 in the Nichol's Coulee Resource Conservation Area (RCA) located on and adjacent to the Charles M. Russell Game Range in North-Central Montana. Both mule deer *(Odocoileus hemionus)* and elk *(Cervus canadensis)* also use parts of this area during at least some seasons. A study was conducted in the RCA on a full time basis during the summer of 1973 and continuous from June 1974 to December 1975 to consider the range ecology of mule deer, elk and cattle. Knowles (1975) reported on summer-fall and Komberec (1976) on winter-spring range relationships of these three ungulates. This report summaries data concerning numbers, classification and distribution of mule deer within Nichol's Coulee RCA during the period of intensive study from 1973 through 1975-76.

DESCRIPTION OF THE STUDY AREA

The study area, of approximately 88,810 acres, is located in south Phillips County, Montana. Knowles (1975) described this area in detail. Pastures III and IV of this four pasture rest-rotation grazing system are located inside the C. M. Russell Game Range (Fig. 1) and are, for the most part, rough timbered breaks. Pastures I and II are mainly rolling prairie lands dissected by entrenched coulees. The grazing formula and pasture treatments by year are shown in Figures 2 and 3, respectively.

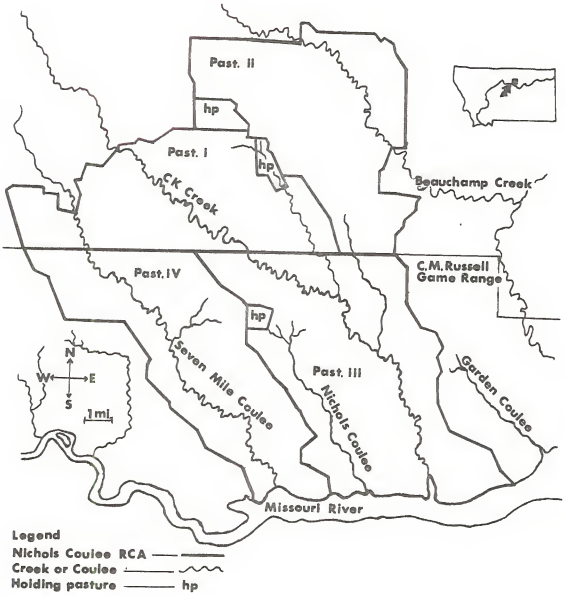

Figure 1. Map of the study area showing drainages and boundaries.

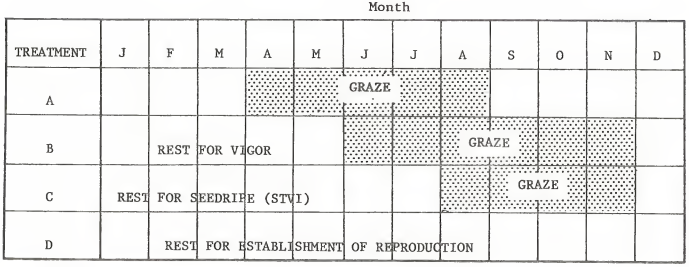

Figure 2. Grazing formula for Nichols Coulee RCA

Years combination occurred
1965
1969
1973

PASTURE I TREATMENT A	PASTURE II TREATMENT D
PASTURE IV TREATMENT B	PASTURE III TREATMENT C

Years combination occurred
1966
1970
1974

PASTURE I TREATMENT A	PASTURE II TREATMENT A
PASTURE IV TREATMENT C	PASTURE III TREATMENT D

Years combination occurred
1967
1971
1975

PASTURE I TREATMENT C	PASTURE II TREATMENT B
PASTURE IV TREATMENT D	PASTURE III TREATMENT A

Years combination occurred
1968
1972
1976

PASTURE I TREATMENT D	PASTURE II TREATMENT C
PASTURE IV TREATMENT A	PASTURE III TREATMENT B

Figure 3. Order of treatments for pastures in Nichols Coulee RCA within and between years.

METHODS

Early winter surveys of pastures III and IV, made from a helicopter, were conducted each year to obtain accurate counts, classifications and distribution of mule deer. Similar data were obtained from fixed wing surveys of pastures I and II during each winter. Two additional aerial surveys of pastures III and IV were made during 1975-1976; one a fixed wing survey in September 1976 and the other a helicopter survey in March 1975. These two surveys, together with the regular early winter survey, provided data for seasonal changes in numbers, classification and distribution during fall and winter 1975-1976.

RESULTS

Numbers of deer counted during the three early winter helicopter surveys of pastures III and IV increased 13.0 percent from 1973-74 to 1975-76 (Table 1). This increase was largely a result of a greater number of adult deer observed in 1975-76. Total numbers of females and males increased about the same, but not proportionately. Increases were 19 percent and 55 percent for females and males, respectively. Hunting statistics for 1974 and 1975 indicated males were removed from the population through hunting at three times the rate of females. These data suggested differential natural mortality rates and/or movements for males and females.

Numbers within each pasture showed greater variation than did total numbers. Maximum numbers counted within each pasture occurred during the year that pasture received the rest treatment. For pasture III in 1974 the increase included greater numbers of both young and adults; while the increase in numbers in pasture IV in 1975 was accounted for only by greater numbers of adults counted. This increase in deer in pasture IV may have been partly related to a more intensive coverage of the upper one-third of pasture IV. However, ground observations from three years of intensive field work indicated that 1975 was the first year for mule deer to make intensive use of this area.

Maximum and minimum fawn:doe ratios in pasture III occurred in years when that pasture received the rest and heavy use treatments, respectively; an apparent inverse relationship to grazing intensity.

In pasture IV an opposite trend was observed; i.e., fawn:doe ratios decreased with decreasing grazing pressures. However, close examination of the data indicated this may have been due to a rather complex combination of off-setting factors. Knowles (1975) reported a difference in the abundance of second year stems of yellow sweet clover *(Melilotus officinalis)*, an important summer forage plant for mule deer, between pastures III and IV in the summer of 1974. This was reflected in greater use of yellow sweet clover during July at mule deer feeding sites in comparable habitat types in pasture III as compared to pasture IV.

Table 1. Early winter mule deer population summaries. Pastures III and IV, Nichols Coulee RCA.

Area	Year	Test	Numbers						Ratios					Density
			Total	Adults	Young	Female	Male	Yearling	Mature	Young:100 Ad	Young:100 F	%Young	Male:100 F	% yearling M	Deer/Sq. Mi.
Pasture III															
	1973 1/	C	145	105	40	76	29 3/	18	11	38.1	52.6	27.6	38.2	62.1	3.2
	1974 2/	D	164	114	50	82	32 3/	16	15	43.9	61.0	30.5	39.0	51.6	3.6
	1975 3/	A	150	122	28	89	33	11	22	23.1	31.5	18.8	40.0	31.2	3.3
Pasture IV															
	1973	B	39	29	10	24	5	0	5	34.5	41.7	25.6	20.8	00.0	1.2
	1974	C	37	30	7	22	8	1	7	23.3	31.8	18.9	36.4	12.5	1.1
	1975	D	58	50	8	30	20	8	12	16.0	26.7	13.8	66.7	40.0	1.8
Combined Pastures															
	1973	CB	184	134	50	100	34	18	16	37.3	50.0	27.2	34.0	52.9	2.3
	1974	DC	201	144	57	104	40	17	22	39.6	54.8	28.4	38.5	43.6	2.6
	1975	AD	208	172	36	119	53	19	34	21.2	30.2	17.4	44.5	34.6	2.7

1/ Survey made from a helicopter January 1-2, 1974.
2/ Survey made from a helicopter January 23-24, 1975
3/ Includes one unclassified male.
4/ Survey made from a helicopter December 5 & 7, 1975

Canopy coverage and percent instances of use for yellow sweet clover were 12 and 56 and 3 and 26 percent for pastures III and IV, respectively. The difference in abundance of yellow sweet clover between pastures was attributed to earlier and more intensive use by cattle of pasture IV than pasture III, associated with grazing treatments in 1972 and 1973. Though the exact mechanism was not identified, it appeared that early and intensive use by cattle lowered the reproductive success of yellow sweet clover. The decline in the fawn:doe ratio observed for mule deer using pasture IV from 1973 to 1974 may in part have been a result of this as well as other possible residual effects of heavy grazing.

The increase in deer numbers with a slight decrease in the fawn:doe ratio observed in pasture IV in 1975-76 may have been largely a result of yearling immigration. One more yearling male was counted in pasture IV in the 1975-76 early winter survey than the total number of fawns counted in that pasture during the previous, 1974-75, early winter survey. Five yearling males were known to have been removed from pasture IV during the 1975 hunting season. If yearling females also immigrated into pasture IV at an equal rate, an increase in the fawn:doe ratio associated with the rest treatment would have been masked by an influx of yearling females into the area.

Data collected from three aerial surveys (Table 2) during 1975-1976 indicated other factors besides pasture treatments could influence numbers and productivity of deer. Fawn:doe ratios were found to decline progressively from early fall 1975 to early spring 1976. The fawn:doe ratio declined 51.2 percent from September to December and the young:adult ratio declined 73.7 percent from December to March. During the later period, total numbers of mule deer counted declined 44 percent. A differential decline in young and adults was observed; 83.3 and 36.6 percent, respectively.

Predation by coyotes was thought to be the proximal factor involved in these declines (Knowles 1976). Though fawn survival was poor in both pastures III and IV up to the December survey, numbers of young and adults changed relatively little from December to March in pasture IV as compared to pasture III. This difference may have been related to pasture treatment during 1975. If so, these data might be indicative of the importance of spring-summer-fall food supplies to the winter survival of fawn. As an alternative explanation, 1.3 to 1.6 deer per square mile may represent a threshold of security for coyote predation in the timbered breaks.

Observations of radio marked deer from August 1974 through August 1976 showed that mule deer were capable of long movements into and out of the study area. These movements were observed among adults as well as yearlings of both sexes. However, no data concerning the movements of females with fawns were obtained. Based on observed movements, mule deer in this portion of the breaks and those observed in adjacent prairie land to the north must be considered as one population.

Table 2. Summary of three aerial surveys during fall, winter, spring 1975-1976. Pastures III and IV, Nichols Coulee RCA.

Period / Area	Numbers					Ratios			
	Total	Adult	Young	Female	Male	Young:100 AD	Young:100 F	% Young	Male 100:F
September[1]									
Pasture III	45	33	12	17	16	36.4	70.6	26.7	94.1
Pasture IV	39	29	10	19	10	34.4	52.6	25.6	52.6
Combined	84	62	22	36	26	35.5	61.1	26.2	72.2
December[2]									
Pasture III	150	122	28	89	33	23.0	31.5	18.7	37.1
Pasture IV	58	50	8	30	20	16.0	26.7	13.8	66.7
Combined	208	172	36	119	53	20.9	30.2	17.3	44.5
March[3]									
Pasture III	61	60	1	-	-	1.7	-	1.6	-
Pasture IV	54	49	5	-	-	10.2	-	9.2	-
Combined	115	109	6	-	-	5.5	-	5.2	-

[1] Survey made from a fix wing.
[2] Survey made from a helicopter.
[3] Survey made from a helicopter.

Population data for pastures I and II (Table 3) have been tabulated separately because of the different survey methods employed. Also, during 1975-76, pastures I and II were not surveyed until early spring (March 1976). Effects of pasture treatments between pastures and between years were not readily apparent. Two population parameters observed in the prairie habitat of pastures I and II stand out in contrast to observations in the timbered breaks habitat of pastures III and IV. Fawn production and/or survival at comparable time periods all three years was considerably greater in pastures I and II. This was especially true in 1975-1976 when high fall and winter mortality was observed for fawns in pastures III and IV. However, this was also the year of poorest fawn survival in pastures I and II just as it was for pastures III and IV. Observed mule deer density in pastures I and II appeared to be only 1/7 to 1/3 of that observed in pastures III and IV.

Numbers observed in pastures I and II one year were not consistent with the number and/or proportions of fawn observed in the previous year, indicating either variation in the accuracy of surveys or considerable immigration-emigration between years.

DISCUSSION

This research effort was initiated primarily to determine the effects of rest rotation grazing on mule deer and elk. After three years of intensive field work it became apparent that this approach was attempting to determine the affects of one of several environmental factors which ultimately effect mule deer reproductive success. Consequently, the interaction of factors obscures the real significance of any one factor. Radio telemetry has shown that pastures III and IV of Nichol's Coulee RCA, the area most intensively studied, was only a small part of the total area occupied by a population of prairie-breaks mule deer. This present study was not designed to fully interpret this factor.

Precipitation was well above normal all three years of the study and winters were generally open and mild. This, together with the similarity of weather between years, would appear to have minimized the importance of weather as a variable affecting differences in mule deer reproductive success between years. Production of preferred forage plants also appeared to be generally adequate across the area during this period.

Detailed analysis of the data for pastures III and IV indicated pasture treatments probably effected mule deer numbers and fawn survival and/or productivity to a minor degree. Effects of heavy grazing on fawn production and/or survival were not immediate but appeared to be delayed six months, continuing to the next year's fawn crops. It appeared some adult deer at least were capable of moving considerable distances, including movements between pastures, in response to pasture treatment, as observed for pasture IV during the rest treatment in 1975. Early

Table 3. Winter mule deer population summaries. Pastures I and II, Nichols Coulee RCA.

Area Year	Treat.	Numbers							Ratios					Density
		Total	Adults	Young	Female	Male	Yearling	Mature	Young:100 Ad	Young:100 F	%Young	Male:100 F	% Yearling M	Deer/Sq. Mi.
Pasture I														
1973 1/	A	0	0	0	0	0	0	0	00.0	00.0	00.0	00.0	00.0	0.00
1974 2/	B	12	8	4	6	2	0	2	50.0	66.6	33.3	33.3	00.0	.44
1975 3/	C	15	11	4	–	–	–	–	36.4	–	26.7	–	–	.55
Pasture II														
1973	D	18	9	9	9	0	0	0	100.0	100.0	50.0	00.0	00.0	.56
1974	A	24	11	13	10	1	1	0	118.2	130.0	54.2	10.0	100.0	.76
1975	B	10	8	2	–	–	–	–	25.0	–	20.0	–	–	.31
Combined Pastures														
1973	AD	18	9	9	9	0	0	0	100.0	100.0	50.0	00.0	00.0	.30
1974	BA	36	19	17	16	3	1	2	89.5	106.2	47.2	18.8	33.3	.60
1975	CB	25	19	6	–	–	–	–	31.6	–	24.0	–	–	.42

1/ Survey made from a fixed wing January 4, 1974.
2/ Survey made from a fixed wing January 23, 1975.
3/ Survey made from a fixed wing March 22, 1976.

and continued intensive grazing appeared to affect deer numbers and production negatively while deer responded to late grazing and rest treatment positively with increased numbers and production. Grazing, however, did not appear to be the overriding factor which caused the low to moderate fawn survival observed in early winter each year. The inconsistency of numbers and fawn:doe ratios in relation to pasture treatments for pastures I and II attested to this. These data also show that factors of fawn mortality in the prairie habitat types did not operate to the same degree as observed in the timbered breaks.

Hunting data for 1975 suggested that 15 percent of the preseason population was removed by hunting. Females only accounted for 22 percent of these animals. In years of low fawn survival and/or production, such as observed for 1975-1976, even a low level of harvest of females could conceivably influence the population.

Predation by coyotes may have been an important factor in determining fawn survival. However, predation was only documented during the winter of 1975-1976. Aerial gunning and trapping for coyotes was conducted in the prairie lands north of the Game Range, including parts of pastures I and II, as a control measure for a sheep operation in an adjacent grazing system. This may have been partly responsible for the higher fawn survival observed for pastures I and II.

Elk ranged extensively throughout pastures III and IV but generally concentrated in areas and/or pastures which received little or no grazing during a given year. Elk densities were relatively low even though numbers in the area increased during this period.

It can be concluded that three years of research in this area has not adequately quantified the effects of rest rotation grazing on mule deer numbers and net productivity because of an interaction of factors. The research did point out the complexity of the problem and the need for continued research to more fully understand the influence of livestock grazing on mule deer.

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Knowles, C. J. 1975. Range relationships of mule deer, elk and cattle in a rest-rotation grazing system during summer and fall. M.S. Thesis. Mt. St. Univ. 111pp.

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Komberec, T. J. 1976. Range relationships of mule deer, elk and cattle in a rest-rotation grazing system during winter and spring. M. S. Thesis. Mt. St. Univ. 79pp.

Submitted by: Craig J. Knowles

JOB TITLE: Range relationships of mule deer, elk and cattle in a rest rotation grazing system during winter and spring.[1/]

ABSTRACT:

A study was conducted in the timbered breaks adjacent to the Missouri River, northcentral Montana, during the summer of 1974 and the winter and spring of 1975 to obtain quantitative data on populations, range use and food habits of mule deer, elk and cattle within an area managed by rest-rotation grazing. Seven major habitat types consisting of eleven plant communities were recognized. Numbers, productivity, distribution, and range use of mule deer and elk were determined from one early winter helicopter survey, two fixed-wing airplane surveys and regular ground observations. The fawn:doe ratio was 54.8 for mule deer and the cow:calf ratio was 70.0 for elk in late January 1975. Numbers and distribution of mule deer during the study showed no consistent trends in relation to grazing by cattle and pasture treatments. Numbers and distribution of elk during this study were greatly influenced by grazing of cattle. Elk moved from areas of previous use when cattle began using the area. Home ranges of four marked mule deer were largest for the two adult males and smallest for the female and male fawn. Three radio-collared elk had home ranges much larger than those of the mule deer, with the male having a home range more than twice as large as the home ranges of two female elk. The *Artemisia-Agropyron* habitat type was used most often by both mule deer and elk during winter and spring and by cattle during spring. Marked mule deer and elk used the *Pinus-Juniperus* habitat type most often during both winter and spring. Mule deer, elk and cattle all used 0-10 degree slopes most often during winter and spring. Mule deer and elk preferred southerly exposures during both seasons while cattle used ridge tops and coulee bottoms most often. Food habits were determined from feeding site examinations, supplemented with one cow rumen sample. Browse, forbs, grasses and forbs, browse, grasses was the order of importance of forage classes used by mule deer in winter and spring, respectively. Forbs, grasses, browse was the order of importance of forage classes used by elk in winter. Grasses, forbs, browse was the order of importance of forage classes used by cattle during spring. Yellow sweetclover was the most important forb in the diet of each of the three ungulates. Western wheatgrass was the most important grass in the diet of both elk and cattle. Interspecific relationships, effect of rest rotation grazing and management recommendations of mule deer, elk and cattle on a rest rotation grazing system were discussed.

[1/] This abstract is from the Master's Thesis of Tom Komberec, Montana State University, Bozeman, and is from a study conducted in the Missouri Breaks of northcentral Montana. This final report was published separately earlier in the report period.

Job Title Population ecology and habitat relationships of white-tailed deer on river bottom habitats of eastern Montana.

ABSTRACT:

In late 1975 a study to consider the population ecology of white-tailed deer was initiated in the Missouri River bottomlands in northcentral Montana. Population data collected from the 1975-1976 early winter helicopter survey were presented in relation to similar data from previous years. Major floods of the Missouri River in early June 1964 and 1975 appeared to have detrimental effects on fawn survival. Young:adult ratios were similar both years and averaged 13.6. After the 1964 flood all bottoms below the study area to the UL Bend were flooded and/or annually inundated with the waters of Ft. Peck Reservoir associated with increased reservoir levels. Young:adult ratios from three years data previous to the 1964 flood averaged 72.3 while this ratio for four years of available data between the 1964 and 1974 flood averaged 30.9. Data from animals marked in 1975 and 1976 indicated predation by coyotes during winter was probably an important mortality factor in at least some years.

Job Title: Population ecology and habitat relationships of white-tailed deer on river bottom habitats of eastern Montana.

Job Objective: To determine the environmental requirements of white-tailed deer and factors regulating whitetail populations in major river bottom habitats of eastern Montana.

To determine the effects of various potentially competing land use and management practices upon white-tailed deer in eastern Montana.

To develop new and improved guidelines for management of eastern Montana whitetail populations and their habitats.

INTRODUCTION

White-tailed deer *(Odocoileus virginiana)* occur extensively in river bottom, riparian-agricultural, habitats associated with flood plains of major rivers of Montana. As yet, few data are available on the population ecology and environmental requirements of whitetail populations in these habitats. The only existing study (Allen 1968) was conducted in 1964-65 and primarily concerned range use, foods, condition and productivity of deer on bottomlands of the Missouri River in Northcentral Montana.

To meet the need for further information concerning white-tailed deer in river bottom habitats, this study was established during 1975 on the same area on which Allen's (1968) study was conducted. Field studies were initiated during early winter 1975-76. In view of the preliminary nature of the work, this report primarily concerns population data obtained during the 1975-76 winter and relates findings to comparable data obtained for previous years.

DESCRIPTION OF STUDY AREA

The Study Area

The study area is located on the Charles M. Russell Wildlife Refuge, administered by the U. S. Department of Interior Fish and Wildlife Service. The study area consisted of 20 *bottoms* and three islands included in a straight-line distance of about 23 miles (Fig. 1). The floodplain varied from 1/2 to 1 mile in width and bottoms, ranging in size from 144 to 644 acres, usually alternated between the north and south sides of the river.

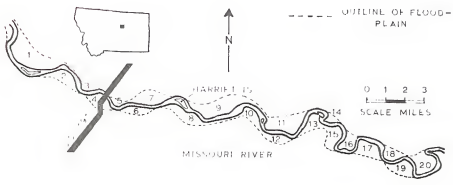

Figure 1. Map of study area.

The ridges overlooking the river are at approximately 2,900 ft elevation and typically slope at a relatively steep angle to the floodplain at approximately 2,270 ft.

Physiography, climate, land usage and vegetation of this area have been described in detail by Allen (1968). Mackie (1970) and Knowles (1975) provide similar data for adjacent uplands.

METHODS

Existing data from prior management surveys and research studies on white-tailed deer on Missouri River bottoms were compiled.

In early winter, December 12, an aerial survey was conducted to count and classify whitetails on the study area. A Bell, 47G 3-B2 helicopter was employed; with the entire survey requiring approximately 1 hr 45 min. All deer observed were classified as to sex and age, if possible. Also, males were further classified by antler size as yearlings or older adults.

During December and early January and again in late April, an attempt was made to trap and individually mark whitetails on the Slippery Ann (9) and Snooks Bottoms (7). Trapping employed the Cannon Net (Mackie et al. 1975) with alfalfa and barley as bait. Captured animals were fitted with 4-inch wide collars of Armor-tite material or with radio-transmitter collars.

Periodic ground and aerial (Piper Supercub) observations were made through the winter to early May to determine movements of collared animals, habitat type usage, numbers of whitetails on various bottomland areas, and fawn survival.

The U. S. Fish and Wildlife Service, Charles M. Russell Wildlife Range provided facilities and other assistance in the study.

RESULTS

NUMBERS, PRODUCTIVITY AND DISTRIBUTION

Table 1 shows numbers and sex and age composition during the early winter (December 1975) helicopter survey of the study area in relation to similar data for previous years. Total whitetail numbers in December 1975 appeared to be down substantially from the previous helicopter surveys as a result of fewer fawns and adults being counted. Young:adult and fawn:doe ratios in 1975 were similar to those reported by Allen (1968) in December 1964; and were the lowest observed since that year. In both 1964 and 1975 major floods in early June inundated most of the bottomlands of the study area. The low fawn survival and/or production observed during these two years can probably be attributed to these floods, either directly or indirectly by altering deer distribution and/or forage conditions on the study area.

The year 1964 marked a major change in the ecology of white-tailed deer along the Missouri River in this area. All bottoms below the study area to UL Bend which prior to 1964 were available to and used extensively by deer, were flooded and/or annually inundated with the waters of Ft. Peck Reservoir associated with increased reservoir levels. In 1975 water in Ft. Peck Reservoir was backed up to the lower Rocky Point Bottom (15), a record reservoir level.

Young:adult ratios obtained from ground observations in the three years previous to the 1964 flood averaged 72.3 fawns:100 adults, while ratios obtained from four helicopter surveys between the 1964 and 1975 flood averaged only 30.9:fawns:100 adults. The young:adult ratio averaged only 13.6 during the two flood years. From these data it would appear flooding of the bottomlands and loss of habitat from increased reservoir levels are at least partly responsible for the differences observed in young:adult ratios between periods.

Antler drop in male white-tailed deer apparently begins in mid-December. Fawn:doe and male:female ratios may be underestimated in years that survey work is conducted in late December or early January. This particularly appeared to be the case in surveys of 1965-66 and 1973-74.

The study area was divided into three units based on movements of marked animals and general observations. An upper unit included those bottoms west of U. S. Highway 191 to Two Calf Island (1-upper 4), a middle unit

Table 1. White-tailed deer numbers, sex and age composition from early winter surveys 1960-1975.

	Numbers							Ratios				
Year	Tot.	AD	YG	Fem.	Males[1]	Yrlg	Mat-ure	YG:100 AD	YG:100 FF	% YG	MM:100 FF	% YG MM
1960-61[2]	28	18	10	-	-	-	-	55.5	---	35.7	---	---
1961-62[3]	120	54	66	-	-	-	-	122.0	---	55.0	---	---
1962-63[4]	106	76	30	-	-	-	-	39.5	---	28.3	---	---
1964-65[5]	188	168	20	123	45	14	24	11.9	16.2	10.6	36.6	36.8
1965-66[6]	178	137	41	110	27	3	17	29.9	37.3	23.0	24.5	15.0
1966-67[7]	223	162	61	121	41	10	29	37.6	50.4	27.3	33.9	25.6
1971-72[8]	267	182	60	139	43	-	-	33.0	43.2	22.5	30.1	---
1973-74[9]	207	168	39	146	22	9	13	23.2	26.7	18.8	15.1	40.9
1975-76[10]	121	105	16	76	29	8	21	15.2	21.0	13.2	38.2	27.6

[1] Includes unclassified males.

[2] Sample classified ground late November - early January.

[3] Sample classified ground January 8 - January 12, 1963.

[4] Sample classified ground late November - early January.

[5] Helicopter survey December 29 and 30, 1964. Complete coverage also includes Grand Island.

[6] Helicopter survey December 30 and 31, 1965. Incomplete, Middle and Lower Units only.

[7] Helicopter survey December 19, 22 and 23, 1966. Incomplete, Middle and Lower Units only.

[8] Helicopter survey December 29, 1971. Complete.

[9] Helicopter survey January 1, 1974. Complete.

[10] Helicopter survey December 12, 1975. Complete.

included bottoms from the highway east to the Mauland Bottom at the mouth of Sand Creek (lower 4-10), and a lower unit included all bottoms below this point to the reservoir (11-20). These divisions did not necessarily designate separate populations but appeared to be logical breaking points based on deer movements, habitat and severity and frequency of flooding, which in most cases for bottoms east of the highway was inversely related to distance from the reservoir.

Data were collected only in four years (64-65, 71-72, 73-74, and 75-76) which allowed breakdown of numbers by unit (Table 2). From these data two trends are apparent. The upper unit averaged a higher fawn:doe ratio (50.4) than the middle and lower units (25.6 and 28.8, respectively) during the entire period. Numbers in all units after the 1964 flood apparently increased until 1971-1972 and then the middle and lower units decreased to 1975-76 by 46.1 and 90.6 percent, respectively. In the upper unit numbers continued to increase by approximately 57.9 percent during the same period of time. These differences may be attributed to changes in habitat due to differing degrees of flooding and/or changes in land use practices (agriculture and livestock grazing).

Marked Deer

Thirty-one individual white-tailed deer (12 males, 19 females) were caught and marked during December and January 1975-76 and in late April early May 1976. There were four recaptures. One, a mature male originally marked on December 27, 1975, was recaptured twice within a three hour period on January 14, 1976. Only one of four radio-collared females and 11 of the 28 white-tailed deer marked in winter were known to have survived to April. Nine marked deer were known to have died; one male from unknown causes, one female from accident and seven females were probable coyote kills. Fates of eight deer remained unknown. Knowles (1976) provided additional information on coyote predation on white-tailed deer during the winter 1975-76. Two additional radios were put on females during the April-May trapping period. These two deer subsequently died in early August 1976, apparently of a disease.

DISCUSSION

Allen's work in 1964-65, the aerial surveys and some ground classifications in the early 60's are the only quantitative data available concerning white-tailed deer in the Missouri River Breaks. Interpretation of available data is difficult because little field work was done except in 1964-65 and 1975-76. Three important factors influencing white-tailed deer on the study area are readily apparent, however. Repeated flooding of the lower unit from 1964 up to the present has resulted in loss and/or change in habitat and probably influenced "normal" habitat use patterns and forage values for whitetails using those bottomlands. Whitetails displaced from inundated bottomlands below the present study area or with periodic flooding clearly were not incorporated into populations of bottomlands above these flooded areas; but rather appeared to be lost to the population. Human land use practices (Agriculture and livestock

Table 2. Numbers and fawn:doe ratios for white-tailed deer by unit as observed from four complete helicopter surveys of the study area.

	Area											
	Upper Unit				Middle Unit				Lower Unit			
	Numbers			Ratio	Numbers			Ratio	Numbers			Ratio
Year	Tot.	YG	FF	YG:100 FF	Tot.	YG	FF	YG:100 FF	Tot.	YG	FF	YG:100 FF
1964-65	12[1]	1	5	20.0	105	15	70	21.4	71	5	50	10.0
1971-72	19	5	5	100.0	152	34	83	41.0	96	21	51	41.2
1973-74	18	6	12	50.0	135	25	101	24.7	54	8	33	24.2
1975-76	30	6	19	31.6	82	8	52	15.4	9	2	5	40.0

[1]Includes nine deer on Grand Island.

grazing) on the bottomlands have also changed with flooding and changes in management policies of the U. S. Fish and Wildlife Service. Coyote predation, though not fully understood, appeared to be great enough to influence the deer population in at least some years. At this time the role of disease remains unknown, but, based on observations during the summer of 1976, could be of considerable significance in connection with or in addition to other factors.

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Mackie, R. J. 1970. Range ecology of mule deer, elk and cattle in the Missouri River Breaks. Wildl. Monogr., No. 20, 77 pp.

Submitted by: Richard J. Mackie

Craig J. Knowles

JOB TITLE: Observations of coyote predation on mule deer and white-tailed deer in the Missouri River Breaks, 1975-1976.

ABSTRACT:

Early winter aerial population surveys for the Missouri River Breaks (Northcentral Montana) for the past five years have indicated low mule and white-tailed deer fawn survival and/or production. An intensive effort to determine probable causes was made during 1975-1976. Mule deer were studied both North and South of the Missouri River (North and South Study Areas) and white-tailed deer on the bottomlands of the Missouri River (Bottomland Study Area). High initial fawn production (162.5 fawns:100 producing females) was observed for mule deer on the North Study Area in June 1975. An early fall (Sept.-Oct.) aerial survey indicated only moderate mule deer fawn survival for both the North and South Study Areas (55.9 and 72.0 fawns:100 females, respectively). The early winter (December) helicopter survey indicated mule deer fawn:doe ratios decreased 51.2 and 35.0 percent from early fall for the North and South Study Areas, respectively. The early spring (March) helicopter survey of the North and South Study Areas showed an additional loss of fawns during winter; young:adults ratios declined 73.7 and 70.2 percent, respectively, during this period. Numbers of deer counted on the North Study Area declined 44 percent from December to March. The extent and causes of losses of mule deer fawns in summer was unknown. Predation by coyotes ranked high as a probable cause of loss of mule deer fawns in fall, while direct evidence of coyote predation during winter indicated this to be the proximal cause in the loss of fawn and adult mule and white-tailed deer. Analysis of 66 deer which were probably killed by coyotes during winter were discussed in detail.

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Job Objectives: To determine the environmental requirements of mule deer and white-tailed deer and factors regulating deer populations in the river bottom and breaks habitat types of eastern Montana.

INTRODUCTION

Errington (1946) noted that in discussion of predation on vertebrates few quantitative data were available and that the population significance of predation mortality seldom received critical treatment. His findings indicated that muskrat populations were not controlled by predation but instead by intraspecific strife as a result of deficiencies in habitat. Predation mortality was in fact intercompensatory to other limiting mortality factors. Errington thought principles observed for muskrats varied only in degree from those influencing ungulate populations.

Hornocker (1971) found that the territorial nature of mountain lions prevented them from controling elk populations in Idaho, and predation was compensatory to other mortality. Mech (1970), however, thought that wolves, despite intraspecific population controls, were an important factor influencing the moose population of Isle Royal but was not certain they exerted any long term effect.

The last two studies both examined predators primarily specific to one prey species. The effects of short term predation on an ungulate population by a generalized predator whose numbers may not be dependent on any one prey species has not been adequately investigated.

Early winter aerial population surveys for the Missouri River Breaks (North-central Montana) for the past five years have indicated low-moderate mule deer fawn survival and/or production. Initially the first two years of low fawn:doe ratios (1971-72 and 1972-73) were attributed directly to the severe winter of 1971-1972 (Mackie pers. comm.). A moderately low ratio for 1973-1974 may have been partially effected by lag effects from that severe winter (Mackie pers. comm.). During the last two years, however, despite four consecutive years of average or above spring-summer precipitation and relatively open mild winters, fawn survival has remained low. This has occurred concomitant with the ban on the use of sodium flouroacetate (1080) as a coyote control agent in 1972. Coyote control using 1080, as well as aerial gunning and other techniques was conducted annually over most of the area prior to 1972. Because observations in summer and fall 1975 indicated mule deer fawns were being lost, a study was initiated to investigate coyote predation as a possible cause of low fawn survival in the Missouri River Breaks. This report summarizes initial findings of this study.

DESCRIPTION OF THE STUDY AREA

The study area, located in Northcentral Montana includes the bottom lands and timbered breaks both sides of the Missouri River. The area was divided into three parts: timbered breaks on the south side of the river (South Study Area) described by Mackie (1970), timbered breaks on the north side of the river (North Study Area) described by Knowles (1975) and the bottom lands of the river (Bottom Land Study Area) described by Allen (1968).

During the winter of 1975-1976 snow began to accumulate in late November shortly after Ft. Peck Reservoir froze, and by mid-December, after a series of small snow storms, 8-10" of snow was on the ground. December, though the mean temperature was slightly above normal (Table 1), was the coldest month during the winter period. January, February, and March were characterized by windy and relatively mild weather interspersed with infrequent, light snowfalls and cold temperatures. South slopes were snow covered only during December, level upland areas were mostly snow free after early March and north slopes remained snow and ice covered until late March. River and reservoir ice broke up abruptly between March 22-24, 1976.

METHODS

Data were gathered from systematic ground observations in the North Study Area during summer and fall 1975 and random coverage of all study areas during winter. A Fixed-wing aerial survey of the North and South Study Areas was made during September and October 1975. A complete coverage helicopter survey of all study areas was made in early December 1975. Another helicopter survey with complete coverage of pasture III and IV in the Nichols Coulee Resource Conservation Area (RCA) portion of the North Study Area and partial coverage of the South Study Area was made in late March 1976. Four fixed-wing surveys were made during winter (February 2, February 16, March 5 and March 17) covering 45 mi. of shoreline of the Missouri River and Fort Peck Reservoir from Upper Two Calf Island to four miles east of the mouth of Beauchamp Creek to count deer carcasses on the ice.

RESULTS

Indirect Evidences of Coyote Predation

Between June 16 and June 30, 1975 five of the eight female mule deer observed with fawns in the North Study Area were accompanied by twins. This limited sample suggested high initial fawn production (162.5 fawns: producing female). Early fawn losses were suspected but could not be documented because of the secretive nature of fawns and presence of yearling females. Of five fawns marked with colored ear tags in June of 1975 only one was reobserved. The only observation of this fawn was in mid-July. Ground observations in September (Table 2) and the September-October fixed wing aerial survey (Table 3) indicated only moderate fawn survival. This suggested that some fawns were lost during the

TABLE 1. MEAN MONTHLY TEMPERATURES, PRECIPITATION AND SNOWFALL TOGETHER WITH 11 YEAR MEANS FOR TEMPERATURES AND PRECIPITATION NOVEMBER-APRIL. U.S. DEPT OF COMMERCE WEATHER SERVICE STATION ROY 24NE (Mobridge), MONTANA.

Month	Temperature (Degree F) 1975-1976	11-Yr 1/ Mean	Precipitation (inches) 1975-1976	11-Yr. Mean	Snowfall (inches) 1975-1976
November	30.5	31.2	.63	.32	13.7
December	20.6	17.3	.63	.43	10.3
January	22.4	11.7	.17	.58	3.1
February	32.9	22.1	.60	.21	8.0
March	32.3	31.8	.57	.57	7.3
April	49.0	44.1	.65	1.36	2.0

1/ No data January and February 1964.

TABLE 2. MULE DEER FAWN:DOE RATIOS BY MONTH FROM GROUND OBSERVATION IN THE NORTH STUDY AREA FALL 1975.

MONTH	SAMPLE SIZE NO. YG	NO. FF	YG:100 FF
September	46	82	56.1
October	37	75	49.3
November	43	109	39.4

TABLE 3. MULE DEER CLASSIFICATIONS FROM A FIXED-WING SURVEY OF NORTH AND SOUTH STUDY AREAS DURING SEPTEMBER-OCTOBER 1975.

AREA	Sample Size					Ratios			
	Totals	Adults	Young	Females	Males	YG:100 AD	YG:100 Females	Percent YG	Males:100 Females
NORTH STUDY AREA									
Nichols Coulee Totals	84	62	22	36	26	35.5	61.1	26.2	72.2
Pasture III	45	33	12	17	16	36.4	70.6	26.7	94.1
Pasture IV	39	29	10	19	10	34.4	52.6	25.6	52.6
Bridge & Garden Coulees	31	23	8	14	9	34.7	57.1	25.8	64.3
Wilder Coulee	14	11	3	9	2	27.3	33.3	21.4	22.2
North Study Area Totals	129	96	33	59	37	34.4	55.9	25.6	62.7
SOUTH STUDY AREA									
Carrol Coulee	35	28	7	17	11	25.0	41.2	20.0	64.7
Sand Creek[1/]	70	41	29	33	8	70.7	87.9	41.4	24.2
South Study Area Totals	105	69	36	50	19	52.2	72.0	34.3	38.0

1/ Includes Johnson Coulee.

June-August period. Ground observation in the North Study Area indicated another loss of fawns beginning in the latter half of October and continuing through November (Table 2).

The helicopter survey of the North and South Study Areas in early December 1975 (Table 4) confirmed the downward trend observed for mule deer fawn:doe ratios in the North Study Area from ground observations was real and had also occurred in the South Study Area. Fawn:doe ratios from early fall (fixed wing survey) to early December (helicopter survey) decreased 51.2 and 35.0 percent for the North and South Study Areas, respectively. The loss of fawns in both study areas continued through winter and in the North Study Area the data showed a loss of adults also. Forty-four percent fewer mule deer were counted in the March helicopter survey (Table 5) of Nichols Coulee RCA as compared to the December survey of pastures III and IV. The observed decline in numbers was not distributed evenly between adults and fawns or between pastures and areas. Counts declined 36.6 percent and 83.3 percent for adults and fawns, respectively. Notably numbers in pasture IV, the rest pasture, changed relatively little as compared to pasture III, which was grazed season long during 1975. The major decline in mule deer occurred along the west side of CK Creek. Young:adult ratios during this same period declined 73.7 percent for the North Study Area and 70.2 percent with partial coverage of the South Study Area. The lower numbers of deer counted in March may have at least been partially due to somewhat poorer observing conditions.

The December helicopter survey of the Bottomland Study Area (Table 6) indicated poor white-tailed fawn survival and/or production. Ground classification of white-tailed deer in March on the two major wintering areas (Table 6) indicated an 82.2 percent decline in young:adult ratios since December.

Factors contributing to any mule deer fawn loss in summer are only speculative. In general, apparent forage conditions appeared to be excellent. Loss of white-tailed deer habitat in the Bottom Land Study Area as a result of severe flooding in June 1975 may have been a major contributing factor to poor white-tailed fawn survival and/or production. Allen (1968) found very low fawn production and/or survival (16YG:100 FF) under similar flooding conditions in 1964. The causes for loss of mule deer fawns in late fall was again speculative, though predation by coyotes ranked high as a probable cause. Direct evidence of coyote predation on young and adult deer during winter suggested this was one of the major factors contributing to the decline in deer observed during the winter period. However, the fact that on the North Study Area greater losses occurred on the grazed pasture than on the "rest" pasture suggested that some habitat factor associated with cattle grazing may also have been involved.

In contrast with deer, elk calf production and survival on the Study Area has been excellent during the past three years. No direct evidence of coyote predation on elk was observed, nor were any elk carcasses found during aerial surveys. Relatively stable calf:cow ratios through the winter (Table 7) also indicated little predation on elk calves. It is logical to assume the larger size and group characteristics of elk would minimize coyote predation as a mortality factor.

TABLE 4. MULE DEER NUMBERS AND CLASSIFICATIONS FROM A HELICOPTER SURVEY OF THE NORTH AND SOUTH STUDY AREAS EARLY DECEMBER 1975.

AREA	Numbers					Ratios			
	Totals	Adults	Young	Females	Males	YG:100 Ad	YG:100 Females	Percent YG	Males:100 Females
NORTH STUDY AREA									
Nichols Coulee Totals	208	172	36	119	53	20.9	30.2	17.3	44.5
Pasture III	150	122	28	89	33	23.0	31.5	18.7	37.1
Pasture IV	58	50	8	30	20	16.0	26.7	13.8	66.7
Bridge & Garden Coulees	64	55	9	42	13	16.3	21.4	14.1	31.0
Wilder Coulee	8	8	0	4	4	-	-	-	100.0
North Study Area Totals	280	235	45	165	70	19.1	27.3	16.1	41.4
SOUTH STUDY AREA									
Carroll Coulee	103	77	26	65	12	33.8	40.0	25.2	18.5
Sand Creek[1]	220	159	61	121	38	38.4	50.4	27.7	31.4
South Study Area Totals	323	236	87	186	50	36.9	46.8	26.9	26.9

[1]Includes Johnson Coulee.

TABLE 5. MULE DEER NUMBERS AND CLASSIFICATIONS FROM A HELICOPTER SURVEY OF THE NORTH AND SOUTH STUDY AREAS LATE MARCH 1976.

	Numbers				Ratios	
Area	Totals	Adults	Young	Unc.	YG:100 AD	Percent YG
NORTH STUDY AREA						
Pasture III	61	60	1		1.7	1.6
Pasture IV	54	49	5		10.2	9.2
Nichols Coulee Total	115	109	6		5.5	5.2
SOUTH STUDY AREA						
Carroll Coulee	39	37	1	1	2.7	2.6
Sand Creek[1]	154	136	18		13.2	11.7
South Study Area Totals	193	173	19	1	11.0	9.8

[1] Includes Johnson Coulee.

TABLE 6. WHITE-TAILED DEER NUMBERS AND CLASSIFICATIONS FROM A HELICOPTER SURVEY OF THE BOTTOM LAND STUDY AREA DECEMBER , 1975 AND GROUND CLASSIFICATIONS OF DEER ON TWO BOTTOMS EARLY MARCH 1976.

Time Period	Tot.	Ad.	YG.	Fem.	Male	YG:100 Adults	YG:100 Females	Per-cent YG.	Males: 100 Females
December	121	105	16	76	29	15.2	21.1	13.2	38.2
March	75	73	2	-	-	2.7	-	2.7	-

TABLE 7. ELK NUMBERS AND CLASSIFICATIONS FROM THREE AERIAL SURVEYS OF NORTH STUDY AREA, 1975-1976.

Time Surveyed	Tot.	Ad.	YG.	Fem.	Male	YG:100 Adults	YG:100 Females	Per-cent YG.	Males: 100 Females
Sept.	87	56	31	40	16	55.3	77.5	35.6	37.5
Early Dec.	83	50	33	44	6	66.0	75.0	39.7	13.6
Late Mar.	87	55	32	47	8	58.2	68.1	36.8	17.0

Direct Evidences of Coyote Predation

The first direct evidence of coyote predation on mule deer was found on November 15. Pieces of mule deer fur and skin were found along the north shore of Ft. Peck Reservoir. Numerous coyote and several deer tracks were observed in the mud. However, no intensive search of the area was made and the event was only casually noted. It was not until December 7, 1975, during the helicopter survey of the North Study Areas that the first actual coyote killed deer was found (Kill No. 1, Table 8). Later the same day a coyote was observed standing on river ice next to an open hole in which an adult female mule deer was swimming (Pyrah, pers. comm.).

From December 7 through March 30 a total of 66 probable coyote killed deer on the study areas were either found by or reported to this researcher (Table 7). Blood on the snow or ice, tracks indicating pursuit by coyotes and/or the manner in which carcasses were consumed were used as criteria as evidences of violent death as a result of coyote predation. In six of six cases where deer were known to have died from causes other than predation, consumption of the carcasses was not nearly so rapid nor as complete.

Predation was most obvious during periods of complete snow cover and colder temperatures (Fig. 1). Undoubtedly kills were more easily located under these conditions but not enough to account for the difference observed with changes in weather. It was not determined if deer were more vulnerable during these periods or if the scarcity of small mammals resulted in a negative energy balance for coyotes during periods of cold and snow. At this time it was common to observe coyotes hunting during daylight hours.

Two actual pursuits on white-tailed deer were witnessed. The first incident on December 17, 1975 (-24^{o}F) involved six coyotes working in three pairs on the Snooks Bottom. During a morning observation period the coyotes were observed for one hour to continually work their way around the bottom, jumping deer from their beds and harassing feeding deer as if testing the deer. Though no all out effort to catch a deer was observed, later in the day in the same area four coyotes were chased from a 3/4 consumed white-tailed deer carcass which was still warm (Kill No. 5). On the evening of March 1, 1976 two coyotes coming from different directions were observed to chase 3 adult white-tailed deer across an agricultural field and then along the base of a steep bank where a coyote killed white-tailed deer had previously been found (Kill No. 14). On this occasion the deer eluded the coyotes.

Two other incidents involving direct coyote deer confrontations were also witnessed. At 8:45 AM December 26, 1975 two coyotes were chased from a neck-banded adult female white-tailed deer in this same agricultural field (Kill No. 9). Forty-five minutes earlier this deer had been observed feeding in this area. The coyotes had attacked the deer on the nose, left flank and rump. It had been hamstrung and an estimated 3-5 lbs. of muscle tissue had been consumed from the thighs. Observations were continued for approximately 1/2 hour after the coyotes departed. The deer's initial

TABLE 8. LIST AND DESCRIPTION OF PROBABLE COYOTE KILLED DEER, MISSOURI RIVER BREAKS STUDY AREAS WINTER 1975-1976.

Kill No.	Date [1]	Spp [2]	Sex [3]	Age [4]	Bone Marr [5]	Habitat	Shore	Slope/ Exposure		Location	Comments
1	12/ 7/75	MD	U	U		Pinus/Junip [6]		25-30°	N	SE34,27E,22N	Killed after 12/5. Completely consumed.
2	12/ 7/75	MD	F	AD	-	River	N	-	-	SE32,25E,22N	Swimming in open water, coyote on ice.
3	12/ 7/75	WT	U	U	-	Alfalfa		Level	-	3,25E,21N	Reported by a rancher.
4	12/12/75	WT	F	AD	WF	Grain		Level	-	SE32,24E,22N	Consumed in 3-4.5 hour period.
5	12/17/75	WT	F	3-4	WF	Popul/Symph		Level	-	SW32,24E,22N	Radio collar. Still warm only head and front leg remain.
6	12/18/75	WT	F	3-4	WF	Sarco/Agrop		Level	-	SE31,25E,22N	Neck banded. Still warm only head and front leg remain.
7	12/24/75	MD	F	1.5	-	Pinus/Junip		25-35°	N	NW 9,28E,21N	Radio collar. Killed at least one week earlier.
8	12/24/75	MD	U	AD	-	Pinus/Junip		15-25°	NE	SW 1,27E,21N	Killed above 6M bank of CK Creek, 1 day old. Consumed.
9	12/26/75	WT	F	4-5	WF	Grass Hay		Level	-	SE34,25E,22N	See Text.
10	12/16/75	WT	U	U	-	River Ice	N	Level	-	SW32,24E,22N	Old kill.
11	12/28/75	WT	U	.5	-	River Ice	N	Level	-	SE 6,21N,25E	Reported by Fish and Wildlife Service.
12	12/28/75	WT	U	U	-	River Ice	N	Level		SE 6,21N,25E	Reported by Fish and Wildlife Service.
13	1/ 8/76	WT	U	2.5	WF	Grain		Level	-	SE32,24E,22N	Same place as Kill 4. Kill <15 hrs. old, parts of hide remained.
14	1/16/76	WT	U	U	-	Grass Hay		Level	-	SE34,24E,22N	Crusted snow next to steep shale bank.
15	1/16/76	MD	U	AD	WF	Sarco/Agrop		Level	-	SW10,27E,21N	50M from reservoir ice at base of steep slope.
16	1/18/76	MD	U	.5	WF	Resv. Ice	N	Level	-	NE13,21N,27E	Killed after 1/16. Consumed.
17	1/23/76	MD	U	U	-	Resv. Ice	N	Level	-	SW10,27E,21N	1/8-1/4 mile from Kill 15.
18	1/24/76	MD	U	3.5	-	River Ice	N	Level	-	SE 9,26E,21N	Since AM of 1/23. Consumed.
19	1/27/76	MD	U	3.5	-	Resv. Ice	S	Level	-	SE13,27E,21N	Since 1/26. Consumed.
20	1/27/76	MD	U	U	-	Resv. Ice	S	Level	-	SW13,27E,21N	1 coyote, 1/4M from Kill 19. Appeared as snow melted.
21	1/28/76	MD	F	8-9		Pinus/Junip		25-30°	NW	NW31,27E,22N	Radio collar. Killed around 1/24 in entrenched cut.
22	1/30/76	MD	M	1.5	YS	Resv. Ice	N	Level	-	NW16,27E,21N	Killed 1/29, below steep bank on shore. Consumed.
23	12/29/75	WT	F	AD	-	River Bot		-	-	33,24E,22N	Neck banded. Collar found in coyote stomach.
24	2/ 1/76	WT	F	AD	-	Popul/Salix		Level	-	SE32,24E,21N	Radio collar. Completely consumed
25	2/ 1/76	WT	F	1.5	-	Agrop/Symph		Level	-	NE33,24E,22N	Radio collar. Site of kill isolated patch of Juniper.
26	2/ 5/76	WT	F	4-5	WF	Popul/Symph		Level	-	SW32,24E,22N	Neck banded. Still warm, head and front legs. Six coyotes in area same place as Kill 6.
27	2/ 2/76	MD	U	U	-	Resv. Ice	N	Level	-	SW 9,28E,21N	Old kill.
28	2/ 2/76	MD	U	U	-	Resv. Ice	N	Level	-	SE 3,28E,21N	Old kill.
29	2/ 2/76	MD	F	6-7	-	Resv. Ice	N	Level	-	NW10,28E,21N	Old kill.
30	2/ 2/76	MD	U	U	-	Resv. Ice	N	Level	-	NW10,28E,21N	Old kill.
31	2/ 2/76	MD	U	U	-	Resv. Ice	N	Level	-	NW13,26E,21N	Old kill, along shore.
32	2/ 2/76	MD	U	U		Resv. Ice	N	Level	-	NW 6,26E,21N	Old kill
33	2/ 2/76	MD	U	U	-	Resv. Ice	S	Level	-	NE23,26E,21N	Old kill, on shore ice.
34	2/ 2/76	MD	U	U	-	Resv. Ice	S	Level	-	SE18,27E,21N	Old kill.
35	2/ 2/76	MD	U	U	-	Resv. Ice	S	Level	-	SW13,27E,21N	Old kill. Five kills this area
36	2/ 2/76	MD	U	U	-	Resv. Ice	S	Level	-	SW13,27E,21N	Old kill.
37	2/ 2/76	MD	U	U	-	Resv. Ice	S	Level	-	SW13,27E,21N	Old kill.

TABLE 8. CONTINUED.

Kill No.	Date	SPP.	Sex	Age	Bone Marr.	Habitat	Shore	Slope/ Exposure		Location	Comments
38	2/ 2/76	MD	U	U	-	Resv. Ice	S	Level	-	SE17,28E,21N	Old kill. 2 coyotes.
39	2/ 2/76	MD	U	U	-	Resv. Ice	S	Level	-	SE17,28E,21N	Old kill.
40	2/ 2/76	MD	U	U	-	Resv. Ice	S	Level	-	NE16,28E,21N	Old kill, on shore ice.
41	2/ 2/76	MD	U	U	-	Resv. Ice	S	Level	-	NW17,29E,21N	Old kill.
42	2/ 8/76	MD	U	U	-	Artem/Agrop		Level	-	SW 9,27E,21N	Old kill appeared as snow melted next to a fence.
43	2/16/76	MD	U	U	-	Resv. Ice	N	Level	-	SE13,26E,21N	Fresh kill near center of reservoir, consumed.
44	2/16/76	MD	U	U	-	River Ice	S	Level	-	SW15,26E,21N	Fresh kill consumed < 24 hours, 3 coyotes in area.
45	2/16/76	MD	U	U	-	Agrop/Symph		-	-	Sand Creek	Reported by R. Watts.
46	2/16/76	MD	U	U	-	Sarco/Agrop		-	-	Rocky Point	Reported by R. Watts.
47	2/27/76	MD	F	1.5	RV	Artem/longi		25-35°	SW	NE10,27E,21N	Radio collar. Looked to be in poor physical condition when last seen alive.
48	3/ 5/76	MD	U	U	-	Resv. Ice	S	Level	SW	SE10,28E,21N	Consumed fresh kill. 2 coyotes in area.
49	3/ 5/76	MD	U	U	-	Resv. Ice	N	Level	-	SE 3,28E,21N	Fresh kill, possibly two deer.
50	3/ 5/76	MD	U	U	-	Resv. Ice	N	Level	-	SW12,27E,21N	Fresh kill consumed below steep bank on shore ice. 2 coyotes.
51	3/ 5/76	MD	U	AD	YS	Resv. Ice	N	Level	-	SE11,27E,21N	Fresh kill consumed below steep bank on shore ice. 2 coyotes.
52	3/ 5/76	MD	U	U	-	Agrop/Symph		Level	-	NW29,25E,23N	Fresh kill consumed entrenched coulee bottom.
53	3/ 5/76	WT	U	U	-	River Ice	N	Level	-	SW34,24E,22N	Fresh kill consumed. 2 coyotes.
54	3/ 5/76	U	U	U	-	River Ice	N	Level	-	SW23,23E,22N	Fresh kill consumed on shore below steep bank.
55	3/ 5/76	WT	U	U	-	River Ice	N	Level	-	NE28,23E,22N	Just killed. 2 coyotes.
56	3/ 6/76	MD	F	3-4	YS	Pinus/Junip		25-35°	NW	SW30,27E,22N	Radio collar. Entrenched coulee cut, probably killed 3/1.
57	3/ 6/76	MD	F	AD	-	Resv. Ice	N	Level	-	NW16,27E,21N	Below steep bank, skull and backbone all that remained, <24 hrs. old. 1 coyote.
58	3/ 7/76	MD	U	U	-	River Ice	S	Level	-	SW 6,26E,21N	Consumed on shore ice. < 24 hrs. old. 1 coyote.
59	3/ 8/76	MD	U	9-10		Resv. Ice	N	Level	-	NE13,26E,21N	Below steep bank on shore ice, consumed. < 24 hrs. old.
60	3/12/76	WT	U	AD	-	River Ice	S	Level	-	SE32,24E,22N	See Text.
61	3/17/76	MD	U	U		Resv. Ice	N	Level	-	SE 3,28E,21N	Old kill. Next to Kill 49.
62	3/17/76	MD	U	U		Resv. Ice	N	Level	-	NE13,27E,21N	Old kill. On shore ice below steep bank.
63	3/17/76	WT	U	U		River Ice	S	Level	-	SW33,24E,22N	Old kill. Same area as Kill 60.
64	3/16/76	WT	U	U		River Ice	N	Level	-	SW32,24E,22N	Killed 3/16/76, consumed by 3/17. 2 coyotes.
65	3/17/76	WT	U	U	-	River Ice	N	Level	-	SW21,23E,22N	Fresh kill on shore ice. Consumed. 1 coyote.
66	3/30/76	MD	F	1.5	RV	Resv.	N	Level	-	NE14,27E,21N	Chased into reservoir by coyotes. Stuck in mud.

1/ Date found or reported.
2/ MD = mule deer WT = white-tailed deer U = undetermined.
3/ F = female M = male U = undetermined.
4/ AD = Adult U = undetermined.
5/ WF = White firm YS = Yellow soft RV = Red viscons.
6/ First Five Letters of Genus; e.g. Junip = Juniperus

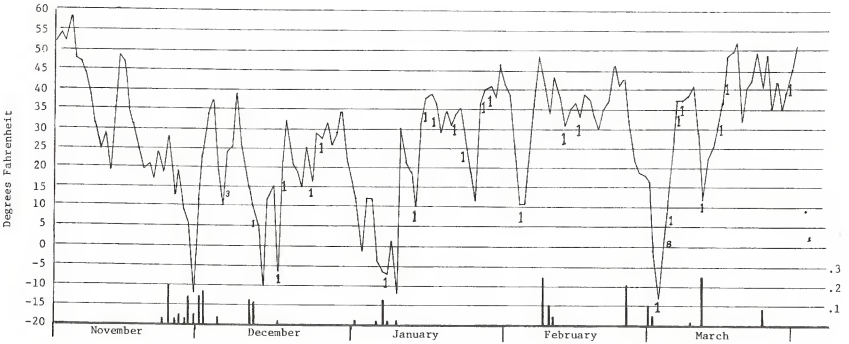


Figure 1. Numbers and approximate dates of probable coyote killed deer in relation to temperature (line graph) and precipitation (Bar graph), November through March.

response was to remain bedded, lick the blood from its nose and left flank and scare magpies away from the large wound in the rear which it could not reach. It then moved approximately 100 yds. by pulling itself along on its front legs before being collected for examination.

On the morning of March 12, 1976 five coyotes were observed to have an adult white-tailed deer trapped on shore ice below a steep bank on the south side of the river opposite Snooks Bottom (Kill No. 60). Tracks in the fresh snow indicated this deer had been chased off the bank by at least two coyotes. During the one hour they were observed, the deer was bedded on the ice and made no attempt to escape while the coyotes stayed close by but made no attempt to attack the deer. Early the next morning all that remained of the deer was a blotch of blood on the ice and contents of the rumen.

Of four partially eaten white-tailed deer carcasses collected (Kills No. 5, 6, 9 and 26), two had been bitten on the nose and all appeared to have been consumed from the hind quarters forward. This would suggest the rump and the head may be the two major points of attack. Mech (1970) reported a similar situation when wolves attacked moose. Once a wolf had hold of the head of a moose, attack from the rear was made easier as the moose was distracted by the wolf on its head.

Coyote killed deer were consumed rapidly. On December 12, 1975 five to six coyotes were observed to eat, dismember, and carry off essentially an entire adult female white-tailed deer in a 3-4.5 hour period (Kill No. 4). On three other occasions partially consumed (only head and front quarters remaining) adult female white-tailed deer carcasses which were still warm (Kills No. 5, 6 and 26) were found on days of zero and below temperatures. A maximum of six coyotes were observed in the immediate area of two deer kills (Kills No. 4 and 26). But never more than three were observed on a carcass at anyone time. Generally, however, only one to three coyotes were observed in the area of a deer kill when coyotes were present. Observations of Kills No. 4 and 26 where coyotes were observed to come and go would suggest that total numbers of coyotes feeding on a carcass was greater than what was observed at any one time. Carcasses in which no muscle tissue remained were considered to be consumed. Coyotes were observed to return to consumed carcasses to eat and/or carry off remaining bones. Generally all that remained at fresh kill sites over 24 hours old were the contents of the rumen, fur and hide, scapulas and possibly dentary bones and parts of the leg bones. One notable exception was a yearling female mule deer (Kill No. 47) whose skeleton, except for the front legs, remained intact for at least one full week. The bone marrow of this deer was red and viscous. The only deer which coyotes were responsible for killing but did not eat was a yearling female mule deer (Kill No. 66) which drowned as a result of getting stuck in mud after being chased into Fort Peck Reservoir by coyotes. No visible signs of attack were present on this deer. Mech (1970) considered flight to water as an escape procedure from predation used by moose.

Duration of evidences of deer kills on reservoir and river ice were found to be highly variable in relation to snowfall, drift and melt. Blood and rumen contents remained until they melted into the ice and were again covered by snow or just covered by snow. In the latter case kill sites usually reappeared as dark blotches on the ice when the snow melted. Remains of at least five deer carcasses and probably several more were found in late January and early February as snow melted off the ice. These deer probably were killed in December during a period of frequent snowfalls and little field work in this area. These five kill sites remained visible until the next measurable snowfall on February 12. Three of three marked carcasses (Kills No. 16, 17 and 18) remained visible for 25, 19 and 20 days until the snowfall of February 12. The latter (No. 18) could still be observed as a dark blotch on the ice on the flight of February 16. Kill sites appearing as dark blotches on the ice were classified as old. Twenty of 22 kill sites found on the February 2 aerial survey of the ice were classified as old. This suggested most of these deer were killed in December or early January as previously described. Two of two and eight of eight deer kills found during the aerial surveys of February 16 and March 5, respectively, were classified as fresh kills. Both these flights followed a fresh snowfall. Three of five kill sites located on the March 17 flight (made a week after a snowstorm) were classified as old kills, probably occurring between the 5th and 11th of March.

Analysis of Coyote Kills

The fact that 52 of 66 coyote killed deer were found on the ice or open agricultural fields probably represents an observability bias more than the inability of coyotes to kill deer in upland situations. Four of the five radio marked mule deer killed by coyotes died in the uplands either at the base of pine covered north slopes and/or in entrenched coulee bottoms. Three of four other mule deer kills found in the uplands were in the same topographic situation. The exception (Kill No. 42) was on a level *Artemisia-Agropyron* ridge top next to a three strand barb wire fence.

Population data for the Nichols Coulee RCA (North Study Area) lends support to the fact coyotes can kill deer at the same or greater frequency in the uplands as they do on reservoir ice. Only eleven deer were known to have died on the reservoir in this area. In all cases of coyote killed mule deer examined it appeared that coyotes gained a competitive advantage by using topographic features and/or meteorological conditions. In addition, three of three radio marked white-tailed deer killed by coyotes were killed in timbered areas of the bottomland or in the uplands. Only one of these three kills, and none of the radio-marked mule deer killed in the uplands were found without the use of the radio receiver.

Six of the nine white-tailed deer kills found on the river ice occurred in the first half of March as the old residual winter snow melted and the deer began to disperse from winter concentration areas. Because of this, it was felt that the 8-10" December snow cover which became crusted in

January and February may have put white-tailed deer at a competitive disadvantage as 10 of 20 white-tailed deer kills examined occurred on level bottomland.

Deer kills appeared to be associated with certain locations (Fig. 2). Mule deer kills were about evenly distributed betweeen the north and south shores of the Reservoir and river in January and February but a sharp increase in numbers of kills on the north shore over those on the south shore was noted in March. This may be a result of the greenup beginning on south slopes adjacent to the north shore in March. Generally deer killed on the ice were killed within 1/8 mi. of shore. As the snow melted off the reservoir deer rarely got past the shore, especially if chased off a steep bank.

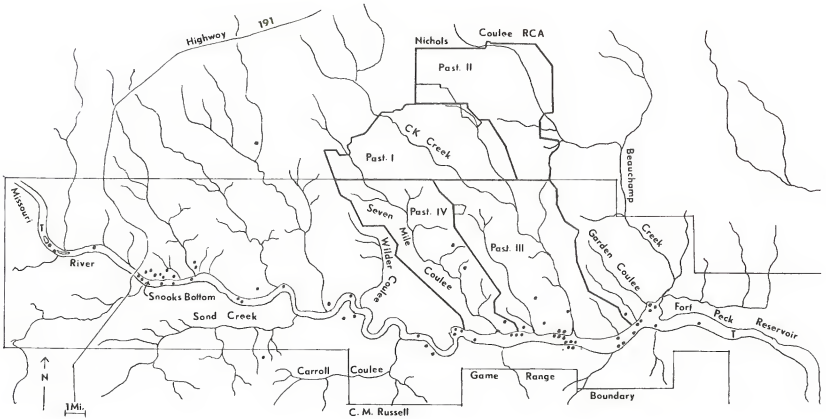
Overall there appeared to be some selection by coyotes for females since both mule and white-tailed deer females appeared in greater percentages among deer kills than their occurrence in the population (Table 8). The appearance of fawns in the winter kill data didn't differ much from their occurrence in the population (Table 9), though evidence of age in carcasses of fawns may be more readily destroyed by coyotes than it is for adults. For both species the bulk of the kill occurred among yearlings and prime age animals (Table 9). However, with mule deer there appeared to be some selection for old age animals as these appeared out of proportion to the old age jaws collected during the fall hunting season (Table 8).

Bone marrow of all white-tailed deer examined had normal fat reserves (Table 9). However, these collections were made between December 12, 1975 and February 5, 1976. Mule deer tended to show a decline in bone marrow fat reserves as winter progressed. However, the two mule deer with red and viscous bone marrow were both yearling females from the same large group of deer.

Stomachs and scats of coyotes on the study area were collected during the winter. Data for the stomachs (Table 10) largely reflects food habits of coyotes feeding in the bottomland study area. Scats have not been quanitatively analyzed as of yet. Distribution of coyotes (Fig. 3) in the North Study Area as observed from the helicopter survey in December correspond closely to distribution of mule deer. The same relationship but to a lesser degree was observed again in March (Fig. 4).

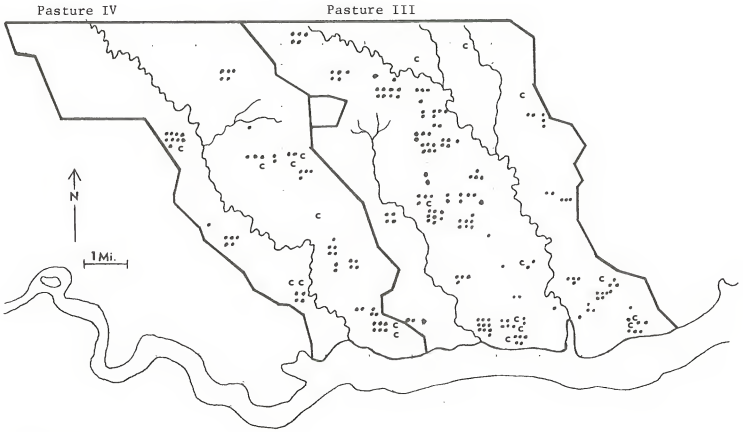
Fates of marked deer showed similar trends as population data. Of 12 mule deer in the North Study Area wearing radios during winter 5 were killed by coyotes, 1 died from injuries sustained in trapping and the status of one remained unknown.

Of seven mule deer marked with radios on the South Study Area during March all survived. Three of four white-tailed deer marked with radios in December and January on the Bottom Land Study Area died as a result of coyote predation. Of the 28 total white-tailed deer marked during this period only 11 could be accounted for at the end of March by which time predation on adult deer appeared to have ended.



Legend
Turn around points _____T.
Location of deer kill _____•

Figure 2. Distribution and location of probable coyote killed deer, winter 1975-76.



Legend
Mule deer •
Coyote c

Figure 3. Location and distribution of mule deer and coyotes as observed from the early December helicopter survey 1975.

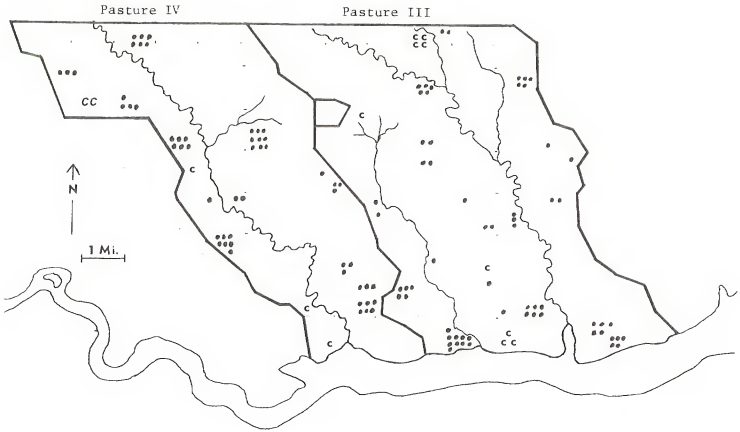


Figure 4. Location and distribution of mule deer and coyotes as observed from the late March helicopter survey 1976.

TABLE 9. SUMMARY OF COYOTE KILLED DEER.

	Species Composition of Kill				
	WT	MD	Unk.	Total	MD Jaws 1975 Hunt. Season
Overall Total	20	45	1	66	
GENERAL KILL SITE					
Res. Ice	-	33	-	33	
River Ice	9	1	1	11	
Bottom Lands	10	2	-	12	
Uplands	1	9	-	10	
SHORE					
North	7	20	1	28	
South	2	14		16	
SEX					
Male	-	1		1	
Female	8	8		16	
AGE					
.5	1	1		2	4
1.5	1	4		5	21
Prime 2-8	5	4		9	15
Old 8+	-	2		2	0
Unk. Ad.	4	5		9	
Total >.5	10	15		25	36
BONE MARROW					
White Firm	6	2		8	
Yellow Soft	-	3		3	
Red Viscous	-	2		2	

TABLE 10. WINTER 1975-76 FOOD HABITS FROM STOMACH ANALYSIS OF 36 COYOTES COLLECTED IN NORTHEAST FERGUS AND SOUTH PHILLIPS COUNTIES. FIGURES ARE PERCENT FREQUENCY OF OCCURRENCE (O)/MEAN AGGREGATE VOLUME PERCENTAGE (V).

ITEM	O/V
Rodent	56/24.0
Rabbit	17/14.1
Other Mammal[1]	72/49.9
Cattle	19.9
Deer[2]	30.0
Bird	14/ 6.4
Invertebrates	3/Tr[3]
Vegetation	11/ 0.1
Miscellaneous	25/ 5.4

[1] Includes carrion.
[2] Includes mule and white-tailed deer.
[3] Less than .05 percent.

DISCUSSION

Factors of mule deer fawn mortality in summer are highly speculative at this point and have not been documented. Mule deer fawn mortality in late fall was documented and appeared to be significant. Coyote predation as a proximal cause was suspected but no direct evidence of predation during this period was confirmed. High fawn mortality in all study areas and adult mortality in the North Study Area was documented for both mule deer and white-tailed deer during winter. Direct evidence of coyote predation indicated this was the proximal factor involved in most cases. The decline in numbers of deer observed in the Nichols Coulee Area from December to March could be partly a result of differences in observability and/or emigration. However, 30 of the 93 less deer can be accounted for. Nineteen died as a result of coyote predation and another 11 marked deer either died of other causes or disappeared during winter. If in fact predation is the primary factor involved in the loss of fawns and overwinter adult mortality, interpretation of available data would indicate the impact of predation on the mule deer population in the North Study Area for the past year has been substantial.

Stable numbers, moderate fawn:doe ratios, and a fair number of yearling males as observed from helicopter surveys of Nichols Coulee RCA for the winters of 1973-74 and 1974-75 (Knowles 1975) would suggest that the high over-winter mortality observed in the winter 1975-76 was exceptional.

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Submitted by: Craig Knowles

JOB TITLE: Population ecology and habitat relationships of mule deer and white-tailed deer in prairie-agricultural habitats of eastern Montana.

ABSTRACT:

A study of factors limiting mule deer and white-tailed deer in the prairie/agricultural habitat of eastern Montana was established on a 230 square mile study area, located northwest of Terry in Prairie and McCone Counties, Montana. The southern portion of the area is comprised mainly of prairie grassland and breaks on which cattle grazing is the dominant land use; while agricultural croplands interspersed by islands of grassland and shrub grass dominated coulees predominate in the north. Fixed wing aerial surveys of the entire study area prior to the hunting season, in December, and in April recorded 119,229, and 233 white-tailed deer respectively; while mule deer numbers were 174,153, and 134, respectively, for the three flights. In fact mule deer numbers exceeded those of white-tails on the southern part of the area and were approximately equal to the latter in the north. During winter and early spring mule deer continued to predominate counts in the south but white-tails greatly predominated in the north. Classifications of white-tails showed 119 fawns per 100 does over the entire area in fall, declining to 78:400 in December. Fawn:adult ratios were 78:100, 61:100, and 75:100 for fall, winter and spring. Mule deer classifications indicated 55 fawns per 100 does in fall and 52:100 in December for the entire areas. Fawn:adult ratios were 42:100, 46:100, and 50:100 for fall, winter, and spring, respectively. Little overwinter mortality of fawns was indicated. Totals of 45 white-tails, including 19 adult males, 12 adult females, and 14 fawns, and 31 mule deer, 18 adult males, 12 adult females, and 4 fawns were checked during the hunting season. Browse utilization measurements during April 1976 showed light use of all species except rubber rabbitbrush for which moderate usage was recorded. Food habits studies indicated that snowberry, rubber rabbitbrush, and rose were important for mule deer during fall. Rubber rabbitbrush, horizontal juniper and silver sagebrush were important in winter. For white-tails, snowberry, rose and barley were important foods during fall and early winter. Two radio-collared, female white-tails had home ranges of approximately 14 square miles during the period 28 January - 14 May, 1976.

Job Title: Population ecology and habitat relationships of mule deer and white-tailed deer in prairie-agricultural habitats of eastern Montana.

Job Objective: To determine the environmental requirements of mule deer and white-tailed deer and factors regulating deer populations in prairie-agricultural habitats in eastern Montana.

To determine the effects of various potentially competing land use and management practices upon deer in eastern Montana.

To develop new and improved guidelines for management of deer populations and their habitats in eastern Montana.

INTRODUCTION

Since 1970, the demand for deer, as indicated by numbers of licenses sold, has increased by one-third. Both deer numbers and the amount of land open or accessible to hunters have declined, at least in some areas of the state during this period. These changes have been reflected in growing concern among game managers and biologists as to the future course of deer management in Montana. A statewide deer research project was begun to obtain more detailed information on deer population biology and habitat relationships. Of particular importance is the determination of what factors are limiting to deer numbers in each of the variety of environments in Montana. The Terry study was established to help determine these factors in the prairie/agricultural habitat of eastern Montana. Field work began in September 1975 and continued through May 1976.

STUDY AREA

The study area is located in north Prairie and southern McCone Counties on the west side of highway 253, starting approximately 10 miles northwest of Terry and extending north to approximately 3 miles south of Brockway. The study area extends as far west as Little Sheep mountain on the south and 6 miles west of Brockway on the north boundary (Fig. 1). Approximately 230 square miles are included within the study area boundaries.

The southern portion of the study area is mainly grassland prairie and prairie breaks with cattle grazing the dominant land use. Grasslands are dissected by coulees dominated by silver sagebrush *(Artemisia cana)* in the lower reaches and progressing upward to bottoms and edges containing snowberry *(Symphoricarpos alba)*, rose *(Rosa* spp.), skunkbush sumac *(Rhus trilobata)* rubber rabbitbrush *(Chrysothamnos nauseosus)*, horizontal

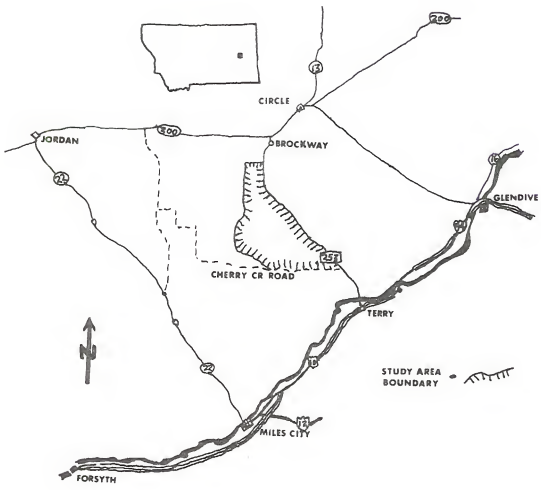

Figure 1. General location of the study area.

juniper *(Juniperus horizontalis)*, chokecherry *(Prunus virginiana)* and silver buffaloberry *(Sheperdia argentia)*. A variety of forbs and grasses are also present. The upper portions of these coulees have overstories of green ash *(Fraxinus pennsylvanica)*.

The northern portion of the study area contains primarily agricultural land with winter wheat, barley, and oats the major crops. Some grazing land is interspersed among the cropland. Creek bottoms contain primarily snowberry, rose and a variety of forbs and grasses in the lower portions but are vegetationally similar to coulees in the southern portion of the study area in the upper portions of the coulees.

Some tentative vegetation types occurring on the area are: *Agropyron smithii-Stipa comata, Agropyron spicatum, Artemisia cana-Agropyron smithii, Fraxinus pennsylvanica-Prunus virginiana, Gutierrezia sarothrae-Agropyron spicatum,* and *Juniperus horizontalis-Agropyron spicatum* (H. Jorgensen, pers. comm.).

During the late 1800's this area was primarily cattle country with large outfits, including the XIT, running cattle on the area. By the late 1890's and through 1910, sheep grazing became a dominant land use and cattle grazing declined. Homesteaders started arriving about 1909 and by 1916 there were farming and people on most every section of land. Grazing of sheep declined with the increasing intensity of homesteading and farming. This area underwent the typical periods of drought and bad winters during the 1920's and the ranks of the homesteaders were severely depleted. Sheep and cattle grazing again became the dominant land use. Unrestricted grazing caused severe problems and the Terry Tribune stated in 1929; "There is no doubt that a majority of our pasture lands are now badly overgrazed." At a Wool Growers Convention in 1944, W. S. Haley of Terry explained, "Been running sheep since 1932", he said, "The grass got so short the cattle couldn't get a taste of it, so I went into the sheep business."

Range conditions have apparently improved since the 1940's. In recent years, however, an increasing amount of pasture land has been plowed up and planted to winter wheat.

HISTORY OF DEER POPULATIONS NEAR TERRY

Little historical information is available on the status of deer populations in the Terry study area. The first closed season on deer was established in 1872. Hunting seasons became increasingly more restrictive until closed entirely in 1921 in McCone County and 1923 in Prairie County. The Terry Tribune reported people from the Terry area making deer hunting trips to the western part of the state starting about 1916. Hunting season for deer remained closed in the Terry area until 1937. The Terry Tribune reported that only 2 local hunters had been able to shoot deer during 1937. The season was closed again in 1938. The season was opened again in 1942 and a 3-day season (1 deer-bucks only) remained in effect

through 1947. During World War II gasoline and ammunition were scarce and few people hunted. In 1944 the Terry Tribune reported, "Some hunters report deer in plenty, others see none. In general, deer were more plentiful this year than usual, but weather conditions are not conducive to good hunting." In 1945 the Terry Tribune reported that there were, "many deer, but few bucks." One of the first places deer were commonly observed, once the increase started, was along the Sheep Mountain Divide, which is contained in the present study area. At the request of local sportsmen the hunting season was closed during 1948 and 1949. From 1952 through 1970 the Terry Tribune made numerous references to "abundant wildlife" and "excellent deer hunting". In 1973 the Terry Tribune reported, "Most hunters reported seeing large numbers of does and fawns but few bucks." Most local people report that the most pronounced decline in deer has occurred since 1973. Hunting pressure, as with much of the State, has increased tremendously, especially since 1970 (Table 1). Hunting seasons have been of two types in hunting district 73 or 730 since 1958 (Table 1). Season A has been 2 deer, either sex with the second tag valid for white-tailed deer only. Harvest during the years this season was in effect (1958-1961, 1966-1970) averaged 72 percent (62-80) mule deer, and 28 percent (20-38) white-tailed deer. Season B has been 2 deer, either sex-either species. Harvest during the years this season was in effect (1962-65, 1971-74) averaged 79 percent (71-90) mule deer and 21 percent (10-29) white-tailed deer. Season A was in effect during 1975 and the harvest was 50 percent mule deer and 50 percent white-tailed deer. These figures point to the recent decline in mule deer numbers.

Deer and antelope apparently increased during the early 1940's in spite of high coyote numbers. During the early 1940's, bounty claims for coyotes in Prairie County were as high and higher than they had been since the 1920's. In 1944, the Terry Tribune reported "The increase in the population of predatory animals in all probability accounts for the decrease of rabbits. Sodiumfloroacetate (1080) was not used in predator control until after 1948, when deer and antelope populations had apparently already started to increase. Many local people comment that although coyote numbers have increased in recent years they are still considerably lower than they were during the early 1940's.

Mule deer apparently have always been the major species of deer in the Terry area. In 1947, Montana Department of Fish and Game personnel estimated that there were 50 white-tailed deer and 1,400 mule deer within the approximately 8,000 square mile Custer Unit, which included the present study area. By 1955, estimates were 1,500 white-tailed deer and 8,120 mule deer in this same area. Despite the questionable accuracy of these estimates, they suggest that relatively few white tails were present. In 1951 the Terry Tribune reported, "The few white-tailed deer are to be found along the Yellowstone River." They also found it worth mentioning that, "several white-tailed bucks were shot in the county." Some local residents feel that white-tailed deer started increasing in Prairie County during the mid-1950's. Today white-tailed deer are abundant on the upland prairie in addition to the river bottom.

TABLE 1. MONTANA DEPT. OF FISH AND GAME HARVEST STATISTICS FOR HUNTING DISTRICT 73.

Year	Type[1] Season	Mule Deer Killed	White-Tailed Deer Killed	Antlered	Antlerless	No. Hunters	Hunter Days
1956		1,345(95)[2]	67(5)				
1958	A	1,057(73)	428(27)				
1960	A	1,081(80)	275(20)	777(60)	572(40)	1,411	
1961	A	1,364(73)	500(27)	1,114(60)	744(40)	1,939	
1962	B	2,019(90)	211(10)	1,260(55)	966(43)	2,272	
1963	B	1,195(71)	418(25)	907(54)	768(45)	1,691	
1964	B	1,809(85)	312(15)	1,451(67)	714(33)	2,066	
1965	B	1,241(77)	377(23)	888(56)	713(44)	1,741	
1966	A	905(62)	547(37)	963(65)	511(35)	1,516	
1967	A	984(73)	326(24)	960(71)	387(29)	1,378	
1968	A	514(74)	156(23)	540(78)	128(19)	696	
1969	A	686(67)	338(33)	687(78)	195(22)	1,062	
1970	A	758(80)	184(20)	739(79)	192(21)	1,005	
1971	B	1,223(77)	366(23)	1,153(71)	465(29)	2,526	7,402
1972	B	1,423(77)	419(23)	1,249(66)	632(34)	3,020	9,346
1973	B	1,951(81)	453(19)	1,587(65)	838(35)	4,003	13,694
1974	B	1,564(72)	603(28)	1,264(57)	944(43)	3,838	12,488
1975	A	828(50)	814(50)	1,012(62)	613(38)	3,695	11,179

[1]A - 2 deer, either sex, B tag WTD only.
B - 2 deer, either sex, either species.
[2]Number (percentage of total).

METHODS

A study area representative of good deer habitat in the prairie grassland-agricultural type was selected during August, 1975 after discussion of objectives with game managers and research personnel and ground-aerial reconnaissance in several areas of eastern Montana. Field studies were initiated in early September. Initially, time was spent becoming familiar with the study area, landowners and deer populations. Montana Department of Fish and Game files were reviewed to become acquainted with existing data for the study area vicinity and other similar areas. Copies of the local newspaper (Terry Tribune), dating back to 1910, were reviewed to obtain the local people's impressions of land use changes and wildlife population changes. Routine daily ground observations were made to obtain data on deer distribution, classifications, habitat use and food habits. Fixed-wing aerial flights were made to obtain population estimates and classifications during three periods: Pre-hunting season (October), post-hunting season (December) and spring (early April).

Information on hunter numbers, harvest, and distribution and deer weights and measurements were obtained during the hunting season. An opening day check station was operated and intensive field checks and voluntary check boxes were used during the remainder of the season.

Deer were captured with a cannon net (Mackie et al. 1976) and helicopter and Cap-chur gun. Radio transmitters or observation collars were attached to those deer caught to facilitate obtaining movements data.

Browse transects were established to obtain percent of the number available leaders utilized on important areas of deer use (Cole 1958). Transect lines varied from 1/4-2 miles in length and a variety of browse plants were randomly selected for sampling as they were encountered along the transect line. Recent deer pellet groups were recorded as encountered along transect lines.

RESULTS

Present Population Parameters

Previous harvest statistics and deer classifications for hunting district 73, which contains the study area, are listed in Tables 1 and 2, respectively.

Table 3 lists classifications during 1975-76 within the study area. Pre-hunting season figures represent only a sample of the population. December and April counts and classifications represent an intensive attempt with a Piper Super Cub to count and classify all deer on the study area. The total number of animals classified during these periods can be considered relatively accurate population estimates. Previous and concurrent ground observations of deer numbers, distribution and group composition indicate that 85-90 percent of the deer on the study area were seen during December and April flights.

TABLE 2. PREVIOUS DEER CLASSIFICATIONS IN HUNTING DISTRICT 73.

Year[1]	Species	Males	Females	Fawns	Total	Fawns/ 100 Adult	Fawns/ 100 Females
1965	MD	5	52	33	90	58	64
1968[2]	MD	16	39	28	83	51	72
1968	MD	0	38	38	76	100	100
1969	MD	28	34	30	92	48	88
1970	MD	29	89	102	220	86	115
1971	MD	24	290	263	577	84	91
1972	MD	4	56	67	127	112	120
1973	MD	47	29	29	105	38	100
1964	WTD	2	39	27	68	66	69
1965	WTD	34	54	38	126	43	70
1971	WTD	1	93	75	169	80	81
1972	WTD	6	26	33	65	103	127

[1]post-season classification unless noted.
[2]pre-season classification.

TABLE 3. DEER CLASSIFICATIONS ON THE TERRY STUDY AREA DURING FALL AND WINTER 1975 AND SPRING 1976.

	Species	Total Animals	Total Males	Ylg. Males	Females	Adults	Fawns	Uncl.	Fawns/ 100 Adults	Fawns/ 100 Females
Pre-season ground & aerial										
South area	WTD	76	13	-	28	41	32	3	78	114
	MD	125	25	-	54	79	31	15	39	57
North area	WTD	43	8	-	14	22	18	3	80	129
	MD	49	3	-	31	33	16	-	49	52
Entire area	WTD	119	21	-	42	63	50	6	78	119
	MD	174	28	-	85	113	47	15	42	55
December aerial										
South area	WTD	83	10	7	34	44	26	12	59	76
	MD	117	9	7	71	80	37	-	46	52
North area	WTD	146	19	9	68	86	53	7	62	78
	MD	35	3	2	22	25	11	-	44	50
Entire area	WTD	229	29	16	102	130	79	19	61	78
	MD	153	12	9	93	105	48	-	46	52
April aerial										
South area	WTD	87	-	-	-	46	36	5	78	-
	MD	108	-	-	-	74	34	-	46	-
North area	WTD	146	-	-	-	84	62	-	73	-
	MD	26	-	-	-	12	9	5	75	-
Entire area	WTD	233	-	-	-	130	98	5	75	-
	MD	134	-	-	-	86	43	5	50	-

I had difficulty classifying white-tailed deer fawns by April and the April figures for fawn/adult ratios are considered to be too high. Ground classifications during March of 156 white-tailed deer indicated a fawn/adult ratio of 64/100 which is similar to the December classification. Spring classifications of white-tailed deer should be made prior to April. Both mule deer and white-tailed deer classifications indicate very little over-winter loss of fawns or adults.

Figure 2 presents winter-spring distribution of mule deer and white-tailed deer groups as determined by both aerial and ground observations.

Hunting Season

Table 4 lists age, sex and species composition of hunter-killed deer checked on the study during 1975. These data indicate a higher proportion of white-tailed deer and antlerless deer (does and fawns) in the harvest than for the hunting district as a whole.

Table 5 lists weights and measurements for hunter-killed deer from the study area during 1975.

Two ranchers agreed to issue permission slips to all who wanted to hunt on their ranches. These data will help to monitor changes in hunter numbers on the study area. During the 1975 hunting season, a total of 78 different parties, with an average of 3.14 people per party, hunted on these two ranches.

Browse Utilization

Table 6 lists percent of browse leaders used on eight browse transects. Only percent of leaders used on each browse plant was measured; percent of length of leader used was not measured. All transects occurred on areas where there was some indication of cattle use of browse plants in addition to deer use. Rubber rabbitbrush showed fairly heavy utilization, but all other browse species measured showed relatively light use.

New pellet groups were recorded as encountered along the transect lines. The number of pellet groups cannot be compared among transects, since the length of transect lines varied. The number of pellet groups recorded may, however, help give a relative index of the intensity of deer use on individual transects from year-to-year.

Food Habits

Tables 7 and 8 list some food habits data for mule deer and white-tailed deer, respectively, on the study area. Results indicate that snowberry, rubber rabbitbrush and rose are important to mule deer during fall. Rubber rabbitbrush remains important throughout the winter, dropping in importance as spring approaches. Horizontal juniper and silver sagebrush

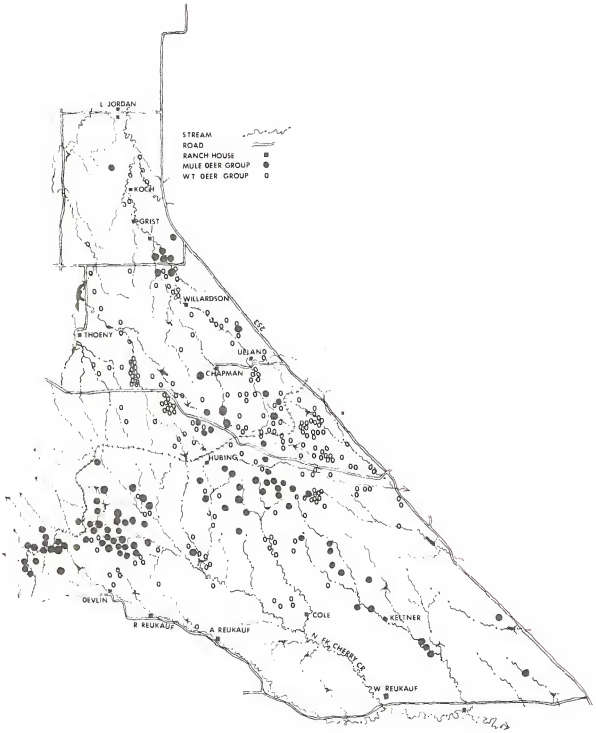

Figure 2. Winter-spring distribution of mule deer and white-tailed deer.

TABLE 4. AGE, SEX AND SPECIES COMPOSITION OF HUNTER-KILLED DEER ON THE TERRY STUDY AREA IN 1975.

White-tailed Deer

Age	Fawn			Yearling			Adult			All				
Sex	Male	Fem.	Tot.	Male	Fem.	Tot.	Male	Fem.	Tot.	Male	Fem.	Ant-ler-ed	Ant-ler-less	Total
No.	9	5	14	7	3	10	12	9	21	28	17	19	26	45
%	20	11	31	16	7	22	27	20	47	62	38	42	58	100

Mule Deer

No.	3	1	4	9	1	10	6	11	17	18	13	15	16	31
%	10	3	13	29	3	32	19	35	55	58	42	48	52	100

TABLE 5. WEIGHTS AND MEASUREMENTS OF HUNTER-KILLED DEER DURING 1975.

Sex	Age	Weight Lbs.	Hind Ft. Length (in.)	Shoulder Height (in.)	Total Length (in.)	Antler Points per Side 1 2 3 4 5	Antler Dia. 1" above Burr
			Mule Deer				
Males	½	55 (2)[1]	16.1 (2)	32.8 (2)	45.2(2)		
	1½	91.8(4)	18.5 (7)	36.6 (4)	54.6(4)	1 8 0 0 0	0.69(8)
	Ad.	143.6(3)	19.4 (5)			0 1 0 5 0	1.02(6)
Females	½	45 (1)	15.0 (1)	28.5 (1)	44.0(1)		
	1½		18.5 (1)	33.0 (1)	51.0(1)		
	Ad.	90.3(3)	18.46(6)	36.75(4)	55.6(5)		
			White-tailed Deer				
Males	½	52.8(5)	15.7 (5)	30.9 (4)	41.6(4)		
	1½	109 (3)	18.4 (3)	36.1 (3)	52.8(3)	2 1 3 0 0	0.74(6)
	Ad.	139.8(6)	19.1 (11)	39.2 (11)	60.5(10)	0 0 2 9 1	1.04(12)
Females	½	46.2(4)	15.4 (5)	28.9 (4)	42.5(4)		
	1½	78 (2)	16.6 (2)	34.0 (1)	51.0(1)		
	Ad.	97.5(4)	18.0 (10)	35.5 (9)	54.4(8)		

[1]Sample size in parenthesis.

TABLE 6. PERCENT OF BROWSE LEADERS USED DURING THE YEAR PRECEDING APRIL 1976.

Transect Number	Number of new Pellet Groups	*Chrysothamnus nauseosus*		*Artemisia spp.*		*Rhus trilobata*		*Symphoricarpos* spp.		*Prunus virginiana*		*Rosa* spp.		*Artemisia tridentata*	
		Number of plants sampled	Percent leaders used	Number of plants sampled	Percent leaders used	Number of plants sampled	Percent leaders used	Number of plants sampled	Percent leaders used	Number of plants sampled	Percent leaders used	Number of plants sampled	Percent leaders used	Number of plants sampled	Percent leaders used
333	104	104	68.4	89	12.3	78	2.7	-	-	34	1.6	-	-	61	2.05
345	19	105	18.9	45	6.45	21	1.67	-	-	-	-	-	-	-	-
400	37	76	55.7	-	-	-	-	-	-	-	-	-	-	-	-
444	25	111	33.7	48	4.0	33	2.1	-	-	29	2.2	-	-	-	-
454	11	62	44.2	-	-	65	0.92	-	-	-	-	-	-	-	-
456	52	88	45.2	113	8.9	52	4.33	71	10.5	31	19.8	-	-	-	-
All (mostly MD use)	248	546	43.6	321	8.6	256	2.65	71	10.5	94	7.8	-	-	61	2.05
399	83	-	-	-	-	-	-	107	40.8	30	35.7	102	22.2	-	-
499	22	-	-	-	-	-	-	44	8.6	103	23.4	-	-	-	-
All (mostly WTD use)	105	-	-	-	-	-	-	151	29.57	133	26.16	102	22.2	-	-

TABLE 7. FOOD HABITS OF MULE DEER ON THE TERRY STUDY AREA DURING FALL AND WINTER.

	October (5 rumens)	January (7 feeding sites)	February (6 feeding sites)	March (7 feeding sites)	March (2 rumens)
Gramineae	6/20[1]	-	-	-	T[2]/50
Forbs					
Glycyrrhiza lepidota	2/40	-	-	-	-
Medicago sativa	1/40	-	-	-	-
Phlox hoodii	-	-	-	-	T/50
Tragopogon dubius	-	1/14	T/16	-	-
Yucca glauca	-	2/14	1/16	-	-
Unid. forbs	T/60	14/14	T/16	-	-
Total Forbs	3/60	17/28	1/16	-	T/50
Browse					
Artemisia cana	T/20	8/42	14/50	31/42	3/100
Chrysothamnos nauseosus	15/100	40/57	70/100	21/28	6/100
Fraxinus pennsylvanica	-	-	-	-	T/50
Juniperus communis	-	-	-	3/14	-
Juniperus horizontalis	-	9/28	15/50	41/57	89/100
Prunus virginiana	-	7/14	-	-	-
Rhus trilobata	-	1/28	-	-	-
Ribes spp.	T/20	-	-	-	-
Rosa spp.	6/100	7/28	-	-	-
Sheperdia argentia	2/40	-	-	-	-
Symphorocarpos alba	63/100	11/14	-	T/14	T/50
Unid. browse	T/40	-	-	-	T/50
Total Browse	87/100	83/86	99/100	96/100	99/100
Other					
Barley	4/40	-	-	-	-

1Percent of diet/frequency of occurrence.
2T = trace - less than 0.5 percent of diet.

TABLE 8. FOOD HABITS OF WHITE-TAILED DEER ON THE TERRY STUDY AREA DURING FALL AND EARLY WINTER.

	October (7 rumens)	November (3 rumens)	January (4 feeding sites)
Gramineae	T[1]/14[2]	1/33	-
Forbs			
Cirsium spp.	T/14	T/67	-
Glycyrrhiza lepidota	T/14	-	-
Medicago sativa	T/14	-	-
Tragopogon dubius	-	-	1/25
Yucca glauca	-	-	5/25
Unid. forbs	T/42	T/67	1/25
Total Forbs	1/42	T/67	7/50
Browse			
Artemisia cana	1/14	-	-
Chrysothamnos nauseosus	3/28	-	-
Fraxinus pennsylvanica	T/14	1/33	-
Juniperus horizontalis	-	-	25/25
Rhus trilobata	-	-	1/25
Rosa spp.	4/71	3/67	30/50
Sheperdia argentia	3/28	-	-
Symphorocarpos alba	66/100	87/100	37/50
Unid. browse	T/14	-	-
Total Browse	78/100	91/100	93/100
Other			
Barley	20/28	9/33	-
Wheat	4/14	-	-

[1] T = tr - less than 0.5 percent of diet.
[2] Percent of diet/frequency of occurrence.

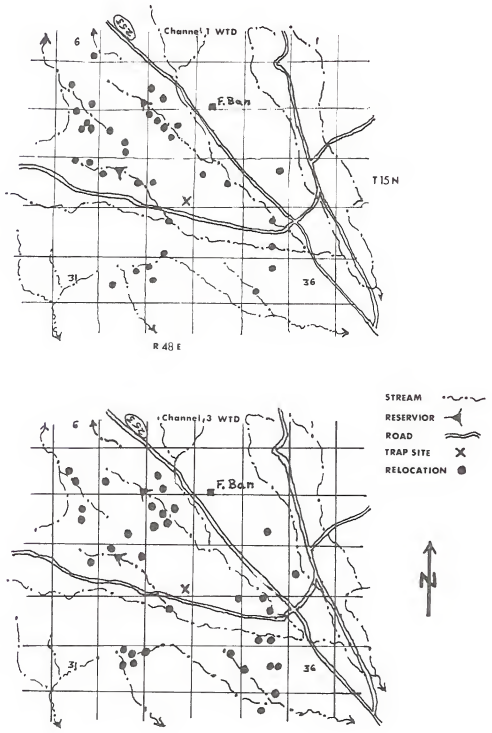

Figure 3. Relocations of two female white-tailed deer during the period 28 January to 13 May 1976.

increase in importance as winter progresses. Data for white-tailed deer food habits indicate that snowberry, rose and barley are important food items during fall and early winter. Data were not collected on white-tailed deer food habits for the remainder of the season.

Movements

Three white-tailed deer and one mule deer were captured and equipped with radio transmitters during winter 1976. In addition, four white-tailed deer were fitted with individually recognizable neckbands. One radioed and one neckbanded white-tailed deer were subsequently found dead. Death was believed to be due to stress and shock associated with capture. In addition, two neckbanded white-tailed deer were not reobserved. Movements data were collected for two radio equipped female white-tailed deer, one radio equipped male mule deer and one neckbanded female white-tailed deer. The mule deer and neck banded white-tailed deer were not observed a sufficient number of times to include movements information in this report.

Figure 3 shows the extent of movements of two female white-tailed deer between 28 January and 13 May 1976. Lines connecting the outermost relocations and enclosing all other relocations indicate that these deer had home ranges of approximately 14 square miles during the period monitored.

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Submitted by: Kenneth L. Hamlin

JOB TITLE: Statewide Deer Carcass Collection

ABSTRACT:

A statewide effort was initiated to record and collect biological materials, particularly reproductive tracts, from deer killed along highways or found dead from other causes throughout the state during winter and spring. Collections were started in January 1976 and continued through May. A total of 307 deer, 75 mule deer and 132 white-tailed deer, was obtained. Fifty seven mule deer and 102 white-tails were recorded as road kills. Usable reproductive tracts were obtained for 18 mule deer 1½ years and older and 31 white-tailed deer, one-half-year-old and older. The 18 mule deer tracts contained 24 embryos or fetuses (1.33/doe) while the 31 white-tails held 42 fetuses (1.36/doe); only one of the 6 fawns collected was pregnant. Results indicate that greater and more complete effort to record kills and to collect reproductive tracts over several years will be required to obtain reasonable samples for determining and comparing reproductive rates for deer among major habitats across Montana.

Job Title: Statewide Deer Carcass Collection

Objectives: To determine the number and distribution of deer killed along roads and highways in Montana; and to determine and compare basic or potential reporductive rates for both species in major habitat types across the State.

INTRODUCTION

Accurate information on the reproductive rates of deer is essential in statewide management as well as in current studies of factors regulating deer populations in diverse habitat types across Montana. Knowledge of both "potential" (number of live fawns expected at parturition) and "realized" (number of live fawns actually recruited into the population at some point after birth) reproduction is required. These data are valuable in assessing population status and trend, comprise an important index to range or habitat quality, and provide a basis for determining the time, extent, and nature or possible causes of post-natal fawn mortality. Basic or potential reproductive rates may vary widely between ranges or over time on the same range in relation to range quality among both white-tails (Cheatum and Serveringhaus 1950, Hesselton and Jackson 1974) and mule deer (Robinette et al. 1955, Julander et al. 1961, Nellis 1968).

Detailed data on reproductive rates at birth are not generally available for either mule deer or white-tailed deer on most Montana ranges. Because of this it usually is difficult to interpret observed fawn:doe ratios for fall, winter, or early spring as measures of reproductive rates and/or to precisely calculate fawn mortality or survival to the time field classifications are made.

The need for better information on reporductive rates of deer throughout the State together with a need to more accurately determine deer mortality from causes other than hunting led to establishment of this study to obtain record of certain biological materials including reproductive tracts from all deer killed or dying from any cause during winter and spring.

PROCEDURES

A request was made to all Fish and Game Department personnel to record and, if available, collect reproductive tracts and biological materials from all deer killed along state highways or found dead from other causes from January through May (Appendix A). Collection efforts were coordinated by deer research personnel located in the western, southwestern, northcentral and eastern portions of the State. Directions for recording basic information,

collecting reproductive tracts, jaws, kidneys, a femur bone, and a one-quart sample of rumen contents, (Appendix B), and collection record forms (Appendix C) were distributed to all department field personnel. In some cases, whole carcasses were collected, while in others, only biological materials were collected. In still other cases, only pertinent data were recorded.

All collections or kill records, collected materials and/or carcasses were transported as soon as possible to the Wildlife Research Laboratory at Bozeman. Here the age of each deer or jaw collected was determined on the basis of tooth replacement and wear (Robinette et al. 1957, Severinghaus 1949); an incisor from each adult was removed for possible later age determination on the basis of annular structure of the dental cementum. Kidney fat and femur marrow fat were measured as outlined by Ransom (1965) and Greer (1965), respectively. Reproductive tracts were examined for fetuses and/or evidence of reproductive activity. Sex, size, and condition of fetuses were recorded. Ovaries were sectioned and examined for the presence of corpora lutea (Cheatum 1949) and/or other evidence of reproductive activity and history. Rumen samples were washed and stored in jars containing formalin for later analysis following procedures outlined by Wilkins (1957) and others.

RESULTS

Mule Deer

Carcasses, biological materials, or some record of death was obtained for 75 mule deer during winter and spring 1976. Nearly two-thirds of these (40) were collected in Administrative Regions 3 and 5, and only 6 were from Regions 1 and 2 west of the Continental Divide. Fifty seven were recorded as road kills, 10 as predator kills, and 8 died from other causes or causes of death was unknown (Table 1).

Sex and age distributions of mule deer in the statewide and various regional collections are presented in Tables 2 through 6. Fawns predominated among all deer examined (47%) and also among the road killed deer (52%). Adult males made up 8 percent of all mule deer examined and 7 percent of the road kills. Adult females comprised 44 percent of the total sample and 42 percent of the road killed sample. Twenty of the 29 fawns for which sex was determined were males.

Only 18 usable reproductive tracts were obtained for mule deer (Table 7). Because of this, reproductive data cannot be analyzed on a regional basis at this time. In spite of the small sample, reproductive data were indicative of good in-utero production on a statewide basis.

White-tailed Deer

Carcasses of 132 white-tailed deer were processed during the 1976 statewide deer collection. The causes of death of these animals are listed, by hunting region, in Table 8. Road-killed deer comprised 77 percent of this sample.

TABLE 1. Numbers and cause of death of 75 mule deer carcasses collected or recorded by Administrative Region and Statewide during 1976.

Location	Cause of Death			
	Road-Kill	Predation	Other	Total
Regions 1, 2	6	0	0	6
Region 3	21	5	3	29
Region 5	20	0	0	20
Regions 4, 6, 7	10	5	5	20
Statewide	57	10	8	75

TABLE 2. Sex and age composition of Statewide mule deer carcass collection, winter-spring 1976.

Age	Male	Female	Unk.	Total
1/2	9	20	5	34
1-1/2	2	6	-	8
2-1/2	-	3	-	3
3-1/2	2	3	-	5
4-1/2	1	2	-	3
5-1/2	-	6	-	6
6-1/2	-	1	-	1
7-1/2	1	1	-	2
8-12	-	4	-	4
12+	-	2	-	2
Unk.	-	4	3	7

TABLE 3. Sex and age of mule deer collected as road kills in Regions 1 and 2 during winter and spring 1976.

Age	Male	Female	Total
1/2	2	1	3
3-1/2	1	1	2
5-1/2		1	1
Total	3	3	6

TABLE 4. Sex and age composition of mule deer collected in Region 3 during winter and spring 1976.

Age	Male	Female	Unk.	Total
1/2	2	8	3	13
1-1/2	1	2		3
4-1/2	1	2		3
5-1/2		2		2
7-1/2	1	1		2
8-12		2		2
12+		2		2
Unk.			2	2
Total	5	19	5	29

TABLE 5. Sex and age composition of mule deer carcasses collected or examined in Region 5 during winter and spring 1976.

Age	Male	Female	Unk.	Total
1/2	3	7	2	12
2-1/2		2		2
3-1/2		2		2
5-1/2		1		1
6-1/2		1		1
8-12		1		1
Unk.		1		1
Total	3	15	2	20

TABLE 6. Sex and age composition of mule deer carcasses from Regions 4, 6 and 7, combined, during winter and spring 1976.

Age	Male	Female	Total
1/2	2	4	6
1-1/2	1	4	5
2-1/2		1	1
3-1/2	1		1
5-1/2		2	2
8-12		1	1
Ad.		4	4
Total	4	16	20

TABLE 7. In-utero reproductive data for yearling and older adult female mule deer examined during winter and spring 1976.

Age	No. embryos/ No. females	No. corpora lutea/ No. females
1-1/2	4/4	3/3
2-1/2+	20/14	16/11

TABLE 8. Cause of death of 132 white-tailed deer in the Statewide deer carcass collection.

Region	Road kill	Coyote	Trap casualty	Poach	Malnutrition	Other
1	52	3	3	3	1	3
2	17	3	3		1	2
3	10					1
4	6					
5	10					1
6		5				1
7	7					
Total	102	11	6	3	2	8

Sex and age classifications of the white-tailed deer in the collection are included in Table 9. Animals were assigned to age-classes according to their ages at 1 January. The collection period extended from late December to early June. Therefore, the fawn or ½-year-age-class includes animals 6 to 12 months of age, and so forth.

Sample sizes from Regions 1 and 2 were sufficient to permit estimates of population parameters. In Region 1 the fawn/doe ratio was 59, the fawn/adult ratio was 40, and the ratio of adult females to adult males was 233. Corresponding figures for Region 2 were 73, 47, and 183.

Twenty-three reproductive tracts were collected in Region 1, and 8 were collected in Region 2. This information is summarized in Table 10. One reproductive tract was collected in Region 3, this from a yearling doe that was pregnant with a single fetus. Two reproductive tracts were collected in Region 4. This included a 3½-year-old that was pregnant with 2 fetuses and a 4+-year-old doe that carried a single fetus. One reproductive tract, from a 2½-year-old doe that carried 2 fetuses, was collected in Region 5. An unclassified adult doe, collected in Region 6, was not pregnant. Four reproductive tracts were collected in Region 7. This sample included two 3½-year-old does that each carried 2 fetuses, an unclassified adult doe that carried two fetuses, and a 4+ doe that was not pregnant.

DISCUSSION AND RECOMMENDATIONS

A total of 307 carcasses, 74 mule deer and 132 white-tailed deer, were examined during winter and spring. This represents a sustantial total in view of the late date (January) when collections began on a statewide basis, the numerous communications and other problems which occurred in getting collections underway throughout the state, and the relatively mild temperatures and light snow conditions which prevailed over most of the state throughout the winter. There was at least some evidence to indicate that much higher totals might have been recorded and greater numbers of usable reproductive tracts obtained if greater effort had been made to locate road kills and/or to collect biological materials at an earlier date in some areas.

The number of usable reproductive tracts collected in this initial effort was very low for both species. If appropriate samples are to be obtained to ascertain reproductive rates on a regional or habitat type basis across the State, both increased effort to locate kills and to collect materials from kills as rapidly as possible after they become available will be necessary. Also, it seems likely that several years of collecting effort may be required in most areas.

In view of the problems encountered in initiating the statewide collection, it seems apparent that if this study is to be successful, greater

TABLE 9. Sex and age classification of 132 white-tailed deer in the Statewide deer carcass collection.

Region	Sample Size	Sex	1/2	1-1/2	2-1/2	3-1/2	4+	Uncl. Ad.	Uncl.
1	65	F	8	6	3	9	11		2
		M	8	5	4	1	3		1
		U	1				1		2
		Total	17	11	7	10	15	0	5
2	26	F	2	3		3	5		
		M	6			1	5		
		U		1					
		Total	8	4	0	4	10	0	0
3	11	F	4	1	1	1	2		
		M	1				1		
		Total	5	1	1	1	3		
4	6	F		1		1	2		
		M	1	1					
		Total	1	2	0	1	2	0	0
5	11	F	1	1	1				
		M	4	1		1		1	
		U	1						
		Total	6	2	1	1	0	1	0
6	6	F			1			4	
		U							1
		Total	0	0	1	0	0	4	1
7	7	F				2	1		1
		M	1	1	1				
		Total	1	1	1	2	1	0	1

TABLE 10. Summary of 23 white-tailed deer reproductive tracts collected in Region 1, and 8 white-tailed deer reproductive tracts collected in Region 2.

Region	No. of Fetuses	1/2	1-1/2	2-1/2	3-1/2	4+
1	0	4				
	1		3		1	3
	2		1	1	4	5
	3			1		
	Fetuses/doe	0	1.25	2.5	1.8	1.63
2	0	1				
	1	1	2			1
	2				2	1
	Fetuses/doe	0.5	1.0		2.0	1.5

effort will be required on the part of all Department personnel, collections must be initiated earlier in the winter, by early-mid December, and improved communications and procedures for collecting and handling materials will have to be achieved.

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Submitted by: Dr. Richard J. Mackie

APPENDIX A

STATE OF MONTANA

DEPARTMENT OF FISH AND GAME

HELENA, MONTANA

Office Memorandum

TO : All Fish and Game Department Personnel **DATE:** January 7, 1976

FROM : Research Section

SUBJECT: DEER CARCASS COLLECTIONS

In connection with the statewide deer research program, an effort will be made to obtain biological data and materials from all deer killed or dying from any cause during winter and spring.

A primary purpose of these collections will be to obtain current information on potential reproduction among deer in various habitats across the state as a base against which observed fawn production and survival can be measured and interpreted. In addition, we may be able to obtain better estimates of the amount and distribution of highway mortality than previously available, information on the sex and age composition of deer dying from causes other than hunting, information on the condition of deer throughout winter and spring, and comparative data on food habits of deer in various habitat types throughout the year.

Your help is needed if this effort is to be successful. You can help by either collecting materials from any deer you find dead (following instructions on the accompanying deer carcass collection forms) or by reporting any dead deer you see or hear about to the nearest research or game management biologist or the regional game manager.

These collections will be discussed at your next regional meeting. If you have any further questions please contact Gene Allen or Dick Mackie in Bozeman.

Thanks for your assistance.

DIRECTIONS FOR HANDLING DEER CARCASSES

I. Collections will include carcasses and/or data and materials for any deer which becomes available including road kills, coyote and/or dog kills, damage control kills, illegal or poaching kills where carcass is recovered, etc.

II. Collection Procedures for each carcass

1. Record information listed on front of this form.
2. Remove jaw from all carcasses.
3. Remove reproductive tract from all females found between December 15 and June 15. Tract should include both ovaries, complete uterus, and all fetuses or unborn fawns.
4. Place jaw and reproductive tract in plastic bag, labeled as to species, date, location, and your collection number corresponding to number on carcass collection form.
5. Collect, in separate plastic bag labeled as above a one-quart sample of rumen contents.
6. If possible, also collect 1 femur bone and kidneys, including surrounding fat. Place in plastic bag with jaw and reproductive tract.

III. Handling Procedures:

1. Collected materials, especially reproductive tracts and rumen samples, should be frozen or preserved in 10% formalin solution if they cannot be delivered within a few days to the Fish and Game Department Wildlife Research Laboratory in Bozeman.
2. Frozen or preserved materials may be taken or sent directly to the Wildlife Laboratory or left at Regional Headquarters or with the nearest research or game management biologist for forwarding to the Wildlife Laboratory. Keep material properly labeled.
3. If biological materials cannot be collected in the field, record pertinent data and take complete carcass to regional headquarters or nearest biologist; or notify regional game manager or nearest biologist immediately of the location of the carcass so that someone can collect the necessary information and biological materials.

APPENDIX C

MONTANA DEPARTMENT OF FISH AND GAME

DEER CARCASS COLLECTION

Coll. No. _____ Date _____ Time _____ Collector _____

Location _____ Cause of Death _____ _____

General Surrounding Habitat _____

Species: _____ Sex: _____ Age: Adult _____ Fawn _____ Jaw _____

Animal Condition

Bone Marrow - Color: White _____ Yellow _____ Red _____

Consistency: Firm _____ Soft _____ Jelly-like _____

Fat: Skin/Brisket _____ Intestinal Cavity _____

Parts Collected: (Circle)

Jaw Reproductive Tract Rumen Sample Femur Kidney

REMARKS: